

N7WXP



ИЛМХО



International Crystal Manufacturing CRYSTAL OSCILLATOR AND FILTER PRODUCTS

QUARTZ CRYSTALS

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| | | | | | | | | | |
|--|--|--|--|--|--|---------------------|--|-----------|--|
| | | | | | | ICM CUSTOMER NUMBER | | PO NUMBER | |
| CUSTOMER NAME (PRINT) | | | | | | | | | |
| STREET ADDRESS (PRINT) | | | | | | | | | |
| CITY | | | | | STATE | | | ZIP | |
| PHONE (AREA CODE FIRST) | | | | | FAX | | | | |
| <input type="checkbox"/> THIS IS MY HOME ADDRESS | | | | | <input type="checkbox"/> THIS IS MY BUSINESS ADDRESS | | | | |

| | | | |
|----------------------------|-------|--------------|-------|
| CHARGE CARD NUMBER | _____ | EXP. DATE | _____ |
| NAME ON CARD (PRINT) | _____ | | |
| REMARKS | _____ | | |
| _____ | | | |
| SIGNATURE | _____ | | |

ALL ORDERS MUST BE SIGNED

NOTE: ALL OK /MO/KS RESIDENTS
MUST ADD APPLICABLE SALES TAX TO ORDER TOTAL.

| ITEM NO. QUANTITY ICM CATALOG NUMBER CHANNEL FREQUENCY (MHz) CRYSTAL FREQUENCY (MHz) | | | | PRICE EA. | EXTENSION |
|--|------|----------|------------|-------------------|-----------|
| _____ | □□□□ | □□□□□□□□ | □□□□□□□□□□ | □□□□□□□□ | |
| _____ | □□□□ | □□□□□□□□ | □□□□□□□□□□ | □□□□□□□□ | |
| _____ | □□□□ | □□□□□□□□ | □□□□□□□□□□ | □□□□□□□□ | |
| _____ | □□□□ | □□□□□□□□ | □□□□□□□□□□ | □□□□□□□□ | |
| | | | | TAX IF APPLICABLE | |

IMPORTANT! IF THIS ORDER IS TO BE SENT BY FAX, PLEASE USE BLACK INK.

TOTAL

TERMS AND CONDITIONS OF SALE

A. ICM does not assume responsibility in collecting applicable state use taxes other than Oklahoma and those states with which Oklahoma has a reciprocal agreement. It is assumed that customers will declare and pay said use taxes to their respective state.

B. All sales are cash with order except where previous arrangements have been made for an approved open account.

C. All ICM crystals are custom made to order and are not stock items, therefore cannot be returned for credit and/or refund.

D. ICM crystals are guaranteed against defective materials and workmanship for an unlimited time when used in the oscillator circuit and/or equipment for which they were designed, except where harsh treatment or user negligence is the cause of failure.



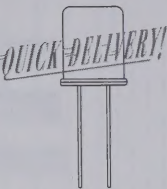

E. A claim for damage in transportation, erroneous count or incorrect product must be made within ten (10) days of receipt of order. Any claim made after this date will not be recognized.

F. Acknowledgments are mailed or faxed for each order, upon receipt please review and advise ICM of any error immediately so corrections can be made.





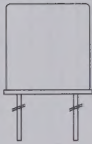

QUARTZ CRYSTAL SELECTION GUIDE

THRU-HOLE CRYSTALS

| PRODUCT | T38 | HC49US | HC49U | HC45U |
|---------------------|--|--|---|--|
| |  |  |  |  |
| Frequency Range | 3.579545 ~ 70 MHz | 3.200 ~ 70 MHz | 1.800 ~ 200 MHz | 3.579545 ~ 200 MHz |
| Frequency Tolerance | ±50PPM | ±30 PPM | ±30 PPM | ±30 PPM |
| Frequency Stability | ±50PPM | ±50 PPM | ±50 PPM | ±50 PPM |
| Temperature Range | -10°C ~ +70°C | 0°C ~ +70°C | -20°C ~ +70°C | -10°C ~ +60°C |
| Key Features | <ul style="list-style-type: none"> ✓ Miniature Package ✓ Very Small Footprint ✓ Cost Effective ✓ High Shock Resistance ✓ "AT" Strip | <ul style="list-style-type: none"> ✓ 3.6mm Profile ✓ Industry Standard ✓ Cost Effective ✓ "AT" Strip | <ul style="list-style-type: none"> ✓ Low Cost ✓ Industry Standard ✓ Wide Freq. Range ✓ Tighter Tolerances | <ul style="list-style-type: none"> ✓ Miniature Pkg. ✓ Wide Freq. Range ✓ Tighter Tolerances ✓ Small Footprint ✓ Excellent Aging |

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Check with ICM Customer Service for available frequencies.

| PRODUCT | HC35/U | HC50/U | HC51/U | T26W/T38W |
|---------------------|--|---|---|--|
| |  |  |  |  |
| Frequency Range | 7.000 ~ 125 MHz | 3.500 ~ 200 MHz | 100 kHz ~ 4.800 MHz | 32.768 kHz |
| Frequency Tolerance | ±30PPM | ±30PPM | ±50PPM | ±20 PPM |
| Frequency Stability | ±50PPM | ±50PPM | ±100PPM | ±0.04 PPM / (Δ°C) ² |
| Temperature Range | -10°C ~ +60°C | -20°C ~ +70°C | -10°C ~ +60°C | -10°C ~ +60°C |
| Key Features | <ul style="list-style-type: none"> ✓ Miniature Package ✓ Very Small Footprint ✓ Tighter Tolerances ✓ Low Phase Noise ✓ Extended Temperature Range | <ul style="list-style-type: none"> ✓ Low Cost ✓ Industry Standard ✓ Third Lead ✓ Wide Freq. Range ✓ Extended Temp. Range | <ul style="list-style-type: none"> ✓ Low Frequency ✓ Excellent Reliability ✓ Third Lead Option | <ul style="list-style-type: none"> ✓ Tuning Fork ✓ Miniature Pkgs. ✓ Low Cost ✓ Cold Weld Design ✓ Long Term Stability ✓ Tight Tolerance |

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Check with ICM Customer Service for available frequencies.


QUARTZ CRYSTAL SELECTION GUIDE - continued**FREQUENCY RANGE BY PRODUCT**



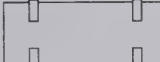
| PRODUCT | 32.768 kHz | 1 MHz | 50 MHz | 70 MHz | 100 MHz | 200 MHz |
|---------------|-------------------|----------------------|--------|--------|---------|---------|
| THRU-HOLE | | | | | | |
| T38 | | 3.579545~70.000 MHz | | | | |
| HC49US | | 3.200~70.000 MHz | | | | |
| HC49U | | 1.800~200.000 MHz | | | | |
| HC45U | | 3.579545~200.000 MHz | | | | |
| HC35U | | 7.00~125.000 MHz | | | | |
| HC50U | | 3.500~200.000 MHz | | | | |
| HC51U | 100 kHz~4.800 MHz | | | | | |
| T26W/T38W | 32.768 kHz | | | | | |
| SURFACE MOUNT | | | | | | |
| S75 | | 9.8304~100.000 MHz | | | | |
| SP135 | | 3.579545~70.000 MHz | | | | |
| SP114 | 32.768 kHz | | | | | |
| SP94 | 32.768 kHz | | | | | |
| HC49S | | 3.200~70.000 MHz | | | | |



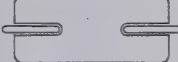
QUARTZ CRYSTAL SELECTION GUIDE

SURFACE MOUNT CRYSTALS

| PRODUCT | S75 |
|---------------------|---|
| |  |
| Frequency Range | 9.8304 ~ 100 MHz |
| Frequency Tolerance | ±50 PPM |
| Frequency Stability | ±50 PPM |
| Temperature Range | -10°C ~ +60°C |
| Key Features | <ul style="list-style-type: none"> ✓ 1.1mm Profile ✓ Wide Freq. Range ✓ Tight Stability Option ✓ "AT" Cut |
| Catalog pages | Page 18 |

| PRODUCT | SP135 | SP114 | SP94 |
|---------------------|---|---|--|
| |  |  |  |
| Frequency Range | 3.579545 ~ 70 MHz | 32.768 kHz | 32.768 kHz |
| Frequency Tolerance | ±50 PPM | ±20 PPM | ±20 PPM |
| Frequency Stability | ±100 PPM | -0.04 PPM / (Δ°C) ² | -0.04 PPM / (Δ°C) ² |
| Temperature Range | -10°C ~ +70°C | -40°C ~ +85°C | -40°C ~ +85°C |
| Key Features | <ul style="list-style-type: none"> ✓ Industry Standard ✓ Cost Effective ✓ High Temp. Seal ✓ Space Saving Design | <ul style="list-style-type: none"> ✓ SMD Watch Crystal ✓ Small Size ✓ Long Term Stability ✓ Industry Standard ✓ 3.56mm Profile | <ul style="list-style-type: none"> ✓ SMD Watch Crystal ✓ Miniature Package ✓ Long Term Stability ✓ 2 Pin Connection Options ✓ 2.5mm Profile |
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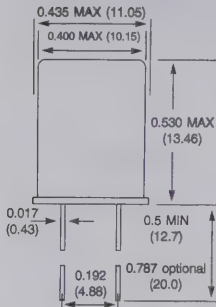
All specifications subject to change without notice.

| PRODUCT | HC49S |
|---------------------|--|
| |  |
| Frequency Range | 3.200~70 MHz |
| Frequency Tolerance | ±30 PPM |
| Frequency Stability | ±50 PPM |
| Temperature Range | 0°C ~ +70°C |
| Key Features | <ul style="list-style-type: none"> ✓ Cost Effective ✓ "AT" Strip ✓ 4.5 mm Profile |
| Catalog pages | Page 11 |

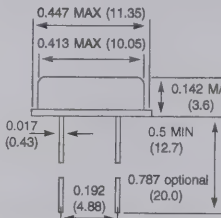
All specifications subject to change without notice.

STANDARD MICROPROCESSOR CRYSTALS

HC49U Resistance Weld



HC49US Resistance Weld



SP135 Surface Mount



SPECIFICATIONS

| PARAMETER | HC49U* | HC49US | SP135 |
|--|----------------|--------------|----------------|
| Frequency Tolerance @ 25°C | ±30 PPM | ±30 PPM | ±50 PPM |
| Frequency Stability over Operating Temperature | ±50 PPM | ±50 PPM | ±100 PPM |
| Operating Temp. Range | -20°C to +70°C | 0°C to +70°C | -10°C to +70°C |

*Optional third lead vinyl sleeves (HC49U only), and mylar spacer
All specifications subject to change without notice.
Inch dimensions shall govern
All dimensions are in inches & parenthetically in millimeters.

| FREQUENCY (MHz) | CL | HC49U Part No. | ESR Ω MAX | HC49US Part No. | ESR Ω MAX | SP135 Part No. | ESR Ω MAX |
|-----------------|--------|----------------|-----------|-----------------|-----------|----------------|-----------|
| 1.000 ** | SERIES | M49010S | 3000 | | | | |
| 1.8432 | 13PF | M49018-13 | 800 | | | | |
| 2.000 | 20PF | M49020-20 | 500 | | | | |
| 2.097152 | 20PF | M49021-20 | 500 | | | | |
| 2.4576 | 32PF | M49024-32 | 300 | | | | |
| 3.579545 | 18PF | M49036-18 | 120 | M49US036S | 200 | SP135036-18 | 200 |
| 3.6864 | SERIES | M490368S | 120 | M49US0368S | 200 | SP1350368S | 200 |
| 3.6864 | 20PF | M490368-20 | 120 | M49US0368-20 | 200 | SP1350368-20 | 200 |
| 4.000 | SERIES | M49040S | 100 | M49US040S | 150 | SP135040S | 150 |
| 4.000 | 20PF | M49040-20 | 100 | M49US040-20 | 150 | SP135040S-20 | 150 |
| 4.096 | 20PF | M490496-20 | 100 | M49US0496-20 | 150 | | |
| 4.194304 | 12PF | M49041-12 | 100 | M49US041-12 | 150 | | |
| 4.433619 | 20PF | M490443-20 | 70 | M49US0443-20 | 150 | | |
| 4.9152 | SERIES | M49049S | 55 | M49US049S | 150 | SP135049S | 150 |
| 4.9152 | 20PF | M49049-20 | 55 | M49US049-20 | 150 | | |
| 5.000 | 20PF | M4905-20 | 50 | | | | |
| 5.0688 | SERIES | M49050S | 50 | | | | |
| 6.000 | SERIES | M49060S | 40 | | | | |
| 6.000 | 20PF | M49060-20 | 40 | | | | |
| 6.144 | 30PF | M49061-30 | 40 | | | | |
| 6.144 | 20PF | M49061-20 | 40 | | | | |
| 7.3728 | SERIES | M49073S | 40 | M49US073S | 80 | SP135073S | 80 |
| 7.3728 | 20PF | M49073-20 | 40 | M49US073-20 | 80 | SP135073-20 | 80 |
| 8.000 | SERIES | M49080S | 35 | M49US080S | 80 | SP135080S | 80 |
| 8.000 | 20PF | M49080-20 | 35 | M49US080-20 | 80 | SP135080-20 | 80 |
| 8.192 | SERIES | M49081S | 35 | | | | |
| 8.192 | 20PF | M49081-20 | 35 | M49US081-20 | 80 | | |
| 9.216 | SERIES | M49092S | 35 | | | | |
| 9.8304 | SERIES | M49098S | 35 | M49US098S | 60 | | |
| 9.8304 | 20PF | M49098-20 | 35 | M49US098-20 | 60 | SP135098-20 | 60 |
| 10.000 | SERIES | M49100S | 30 | M49US100S | 60 | SP135100S | 60 |
| 10.000 | 20PF | M49100-20 | 30 | M49US100-20 | 60 | SP135100-20 | 60 |
| 11.000 | SERIES | M4911S | 30 | | | | |
| 11.000 | 20PF | M4911-20 | 30 | | | | |
| 11.0592 | SERIES | M49115S | 30 | M49US115S | 60 | SP135115S | 60 |
| 11.0592 | 20PF | M49115-20 | 30 | M49US115-20 | 60 | SP135115-20 | 60 |
| 12.000 | SERIES | M49120S | 30 | M49US120S | 60 | SP135120S | 60 |
| 12.000 | 20PF | M49120-20 | 30 | M49US120-20 | 60 | SP135120-20 | 60 |
| 12.288 | SERIES | M49128S | 30 | M49US128S | 60 | SP135128S | 60 |
| 12.288 | 20PF | M49128-20 | 30 | M49US128-20 | 60 | SP135128-20 | 60 |
| 14.31818 | SERIES | M49143S | 25 | M49US143S | 40 | SP135143S | 40 |
| 14.31818 | 20PF | M49143-20 | 25 | M49US143-20 | 40 | SP135143-20 | 40 |
| 14.7456 | SERIES | M49147S | 25 | M49US147S | 40 | SP135147S | 40 |
| 14.7456 | 20PF | M49147-20 | 25 | M49US147-20 | 40 | SP135147-20 | 40 |
| 16.000 | SERIES | M49160S | 25 | M49US160S | 40 | SP135160S | 40 |
| 16.000 | 20PF | M49160-20 | 25 | M49US160-20 | 40 | SP135160-20 | 40 |
| 18.432 | SERIES | M49184S | 20 | | | | |
| 18.432 | 20PF | M49184-20 | 20 | M49US184-20 | 40 | | |
| 19.6608 | SERIES | M49196S | 20 | | | | |
| 19.6608 | 20PF | M49196-20 | 20 | M49US196-20 | 40 | | |
| 20.000 | SERIES | M49200S | 20 | M49US200S | 30 | SP135200S | 30 |
| 20.000 | 20PF | M49200-20 | 20 | M49US200-20 | 30 | SP135200-20 | 30 |
| 22.1184 | SERIES | M49221S | 20 | M49US221S | 30 | | |
| 22.1184 | 20PF | M49221-20 | 20 | | | | |
| 24.000 | SERIES | M49240S | 20 | M49US240S | 30 | | |
| 24.000 | 20PF | M49240-20 | 20 | M49US240S-20 | 30 | SP135240-20 | 30 |
| 32.000 | SERIES | M49320S*** | 40 | | | | |
| 32.000 | 20PF | M49320-20*** | 40 | | | | |

** Frequency Tolerance = ±1000 PPM, Frequency Stability over -10°C to 60°C = ±1000 PPM (SL Cut)

***3rd Overtone



BUILD A CRYSTAL**SAMPLE PART NUMBER:**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E | X | 4 | 9 | D | G | 0 | 0 |
|---|---|---|---|---|---|---|---|

| HOLDER STYLE | | GRADE | | FREQUENCY RANGE | | LOAD | |
|--------------|-------------|-------|-------------|-----------------|--------------------------------|----------|------------------|
| CODE | DESCRIPTION | CODE | DESCRIPTION | CODE | DESCRIPTION | CODE | DESCRIPTION |
| 48 | HC-48/U | H | GOOD | F | 2.00-9.999 MHz Fundamental | 00 | Series Resonant |
| 49 | HC-49/U | D | BETTER | G | 10.000-19.999 MHz Fundamental | | |
| 50 | HC-50/U | A | BEST | H | 20.000-24.999 MHz Fundamental | 10 to 99 | Load Capacitance |
| 45 | HC-45/U | | | L | 20.000-59.999 MHz 3rd Overtone | | In pF |
| | | | | M | 60.000-74.999 MHz 3rd Overtone | | |

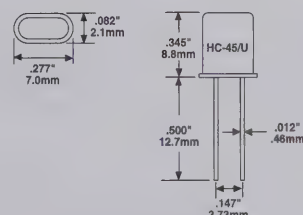
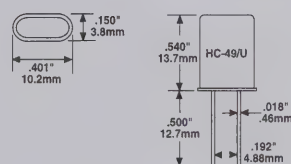
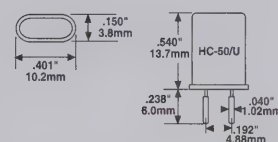
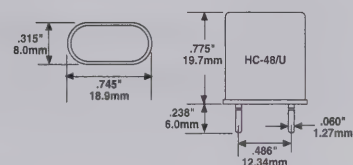
| Specifications: | Calibration Tolerance at 25°C and Specified Load | Temperature Tolerance Relative to 25°C from -30°C to +60°C |
|-----------------|--|--|
| GOOD | ± 50 PPM | ± 50 PPM |
| BETTER | ± 20 PPM | ± 20 PPM |
| BEST | ± 10 PPM | ± 10 PPM |

EQUIVALENT RESISTANCE BY FREQUENCY AND HOLDER

| Standard Holder Style | Freq. Range in MHz | Mode of Operation | Resistance in OHMS* |
|-----------------------|--------------------|-------------------|---------------------|
| HC-48/U | 2.000 - 4.999 | FUNDAMENTAL | 150 |
| HC-48/U | 5.000 - 24.999 | FUNDAMENTAL | 30 |
| HC-49/U, HC-50/U | 3.500 - 5.749 | FUNDAMENTAL | 80 |
| HC-49/U, HC-50/U | 5.750 - 24.999 | FUNDAMENTAL | 30 |
| HC-45/U | 7.500 - 24.999 | FUNDAMENTAL | 30 |
| HC-48/U | 20.000 - 74.999 | 3RD OVERTONE | 40 |
| HC-49/U, HC-50/U | 20.000 - 74.999 | 3RD OVERTONE | 40 |
| HC-45/U | 20.000 - 74.999 | 3RD OVERTONE | 50 |

* UNLESS OTHERWISE STATED, OUR STANDARD DRIVE LEVEL IS 1MW

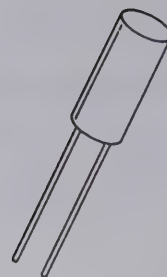
SHUNT CAPACITANCE (CO) IS 7pF MAXIMUM.



MICRO MINIATURE "AT STRIP" CRYSTAL T38

FEATURES

- ✓ Very Small Footprint
- ✓ Miniature Package
- ✓ Cost Effective
- ✓ Rugged Cold Weld Design
- ✓ High Shock Resistance

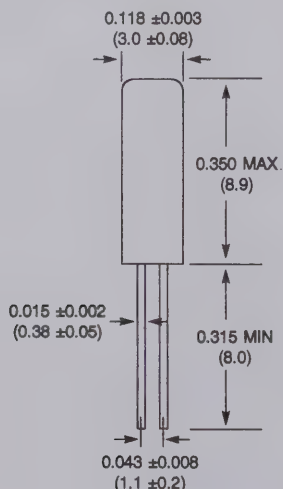


T38 STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|-----------------------|----------|--------|-------|
| Frequency Range | | 3.579545 | 70.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -50 | +50 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -10°C ~ +70°C | -50 | +50 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -10 | +70 | |
| Storage (TSTG) | | -40 | +90 | |
| Shunt Capacitance (C0) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 3.579545 ~ 70.000 MHz | | 0.1 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 3.579 ~ 4.000 | Fundamental | 200 | 9.000 ~ 13.000 | Fundamental | 60 |
| 4.000 ~ 5.000 | Fundamental | 150 | 13.000 ~ 20.000 | Fundamental | 40 |
| 5.000 ~ 6.000 | Fundamental | 120 | 20.000 ~ 30.000 | Fundamental | 30 |
| 6.000 ~ 7.000 | Fundamental | 100 | 30.000 ~ 70.000 | 3rd OT | 100 |
| 7.000 ~ 9.000 | Fundamental | 80 | | | |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches &
parenthetically in millimeters.



RESISTANCE WELD LOW PROFILE CRYSTALS

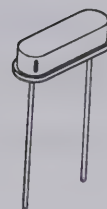
HC49US/S

FEATURES

- ✓ Low Profile
- ✓ Industry Standard
- ✓ Cost Effective
- ✓ "AT Strip"

OPTIONS

- ✓ Surface Mount HC49S
- ✓ Mylar Spacer (Leaded)
- ✓ Tape and Reel (1,000 pcs. STD)



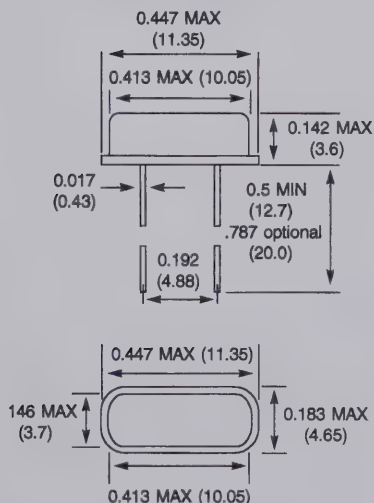
HC49US/S STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|---------------------|-------|--------|-------|
| Frequency Range | | 3.200 | 70.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -30 | +30 | PPM |
| Frequency Stability, ref @ 25°C | Ta = 0°C ~ +70°C | -50 | +50 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | 0 | +70 | |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 3.200 ~ 70.000 MHz | | 0.5 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

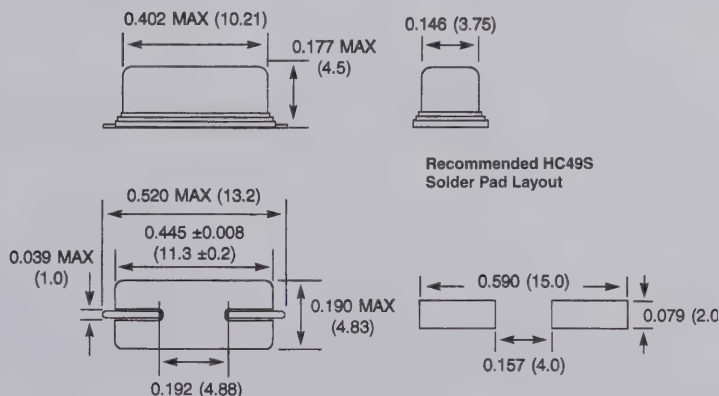
| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 3.200 ~ 3.500 | Fundamental | 300 | 7.000 ~ 9.000 | Fundamental | 80 |
| 3.500 ~ 4.000 | Fundamental | 200 | 9.000 ~ 13.000 | Fundamental | 60 |
| 4.000 ~ 5.000 | Fundamental | 150 | 13.000 ~ 20.000 | Fundamental | 40 |
| 5.000 ~ 6.000 | Fundamental | 120 | 20.000 ~ 30.000 | Fundamental | 30 |
| 6.000 ~ 7.000 | Fundamental | 100 | 27.000 ~ 70.000 | 3rd OT | 100 |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.

HC49US



HC49S



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

RESISTANCE WELD CRYSTAL HC49U

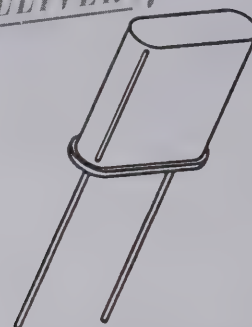
FEATURES

- ✓ Industry Standard
- ✓ Low Cost
- ✓ Wide Frequency Range
- ✓ "AT" Cut Crystal
- ✓ Excellent Aging

OPTIONS

- ✓ Tighter Tolerances
- ✓ Extended Temperature Ranges
- ✓ Mylar Spacer
- ✓ Tape and Reel
- ✓ Vinyl Sleeve
- ✓ Third Lead

QUICK DELIVERY!

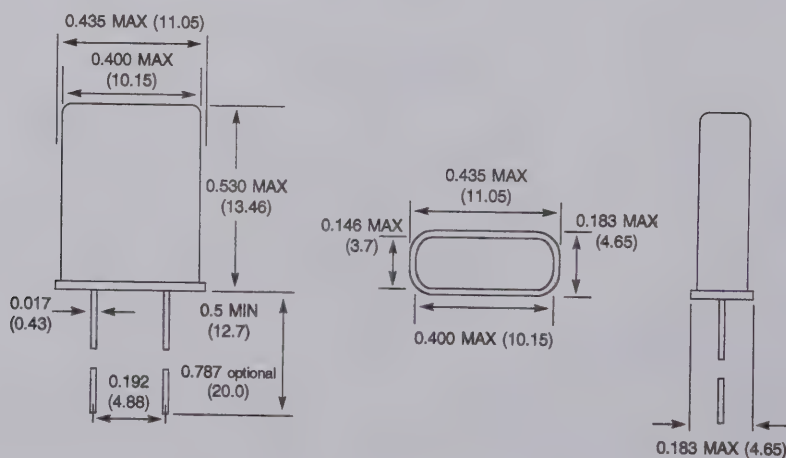


HC49U STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|--|-------|------------|-------|
| Frequency Range | | 1.800 | 200.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -30 | +30 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -20°C ~ +70°C | -50 | +50 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -20 | +70 | |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 1.800 ~ 3.000 MHz 3.000 ~ 200.000 MHz | | 2.0 1.0 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 1.800 ~ 2.000 | Fundamental | 750 | 8.000 ~ 10.000 | Fundamental | 35 |
| 2.000 ~ 2.400 | Fundamental | 500 | 10.000 ~ 12.500 | Fundamental | 30 |
| 2.400 ~ 3.000 | Fundamental | 300 | 12.500 ~ 16.000 | Fundamental | 25 |
| 3.000 ~ 3.200 | Fundamental | 200 | 16.000 ~ 25.000 | Fundamental | 20 |
| 3.200 ~ 3.700 | Fundamental | 120 | 16.000 ~ 23.000 | 3rd OT | 60 |
| 3.700 ~ 4.200 | Fundamental | 100 | 23.000 ~ 65.000 | 3rd OT | 40 |
| 4.200 ~ 4.900 | Fundamental | 70 | 60.000 ~ 110.000 | 5th OT | 80 |
| 4.900 ~ 5.000 | Fundamental | 55 | 110.000 ~ 200.000 | 7th OT | 120 |
| 5.000 ~ 6.000 | Fundamental | 50 | 180.000 ~ 200.000 | 9th OT | 140 |
| 6.000 ~ 8.000 | Fundamental | 40 | | | |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

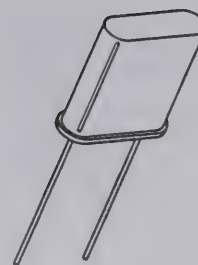


RESISTANCE WELD MINIATURE CRYSTAL HC45U

FEATURES

- ✓ Low Profile
- ✓ Miniature Package
- ✓ Wide Frequency Range
- ✓ Small Footprint
- ✓ Excellent Aging

QUICK DELIVERY!



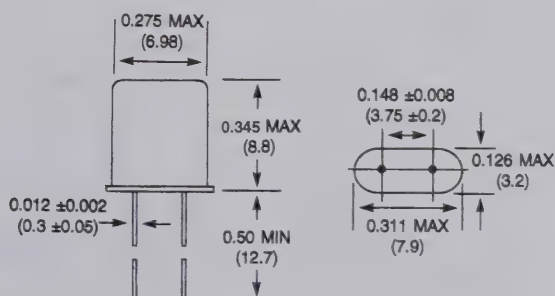
CRYSTALS

HC45U STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|---------------------|----------|---------|-------|
| Frequency Range | | 3.579545 | 200.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -30 | +30 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -10°C ~ +60°C | -50 | +50 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -10 | +60 | |
| Storage (TSTG) | | -40 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 3.579 ~ 200.000 MHz | | 1.0 | mW |
| Aging | Ta = 25°C; per year | -3.0 | +3.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 3.579 ~ 4.000 | Fundamental | 300 | 10.000 ~ 11.000 | Fundamental | 60 |
| 4.000 ~ 5.000 | Fundamental | 250 | 11.000 ~ 27.000 | Fundamental | 40 |
| 5.000 ~ 6.000 | Fundamental | 180 | 25.000 ~ 65.000 | 3rd OT | 60 |
| 6.000 ~ 7.000 | Fundamental | 120 | 60.000 ~ 130.000 | 5th OT | 100 |
| 7.000 ~ 8.000 | Fundamental | 100 | 130.000 ~ 200.000 | 7th OT | 150 |
| 8.000+ ~ 10.000 | Fundamental | 90 | | | |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

RESISTANCE WELD MINIATURE CRYSTAL HC35U

FEATURES

- ✓ High Stability
- ✓ Low Phase Noise
- ✓ Superior Shock & Vibration
- ✓ Tighter Tolerances
- ✓ Smaller Mass for Faster Warm-up in Oven Use
- ✓ Extended Temperature Range

QUICK DELIVERY!

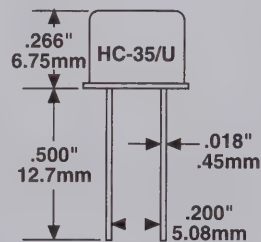
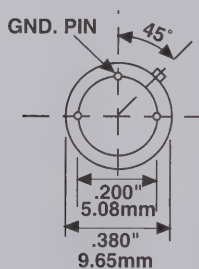


HC35U STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|---------------------|------|---------|-------|
| Frequency Range | | 7.00 | 125.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -30 | +30 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -20°C ~ +70°C | -50 | +50 | PPM |
| Temperature Range | | | | |
| Operating (TOPR) | | -10 | +60 | °C |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 7.00 ~ 125.000 MHz | | 1.0 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|
| 7.000 ~ 10.999 | Fundamental | 30 |
| 11.000 ~ 20.000 | Fundamental | 25 |
| 21.000 ~ 61.000 | 3rd Overtone | 40 |
| 50.000 ~ 125.000 | 5th Overtone | 60 |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



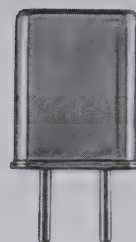
RESISTANCE WELD MINIATURE CRYSTAL HC50U

FEATURES

- ✓ Industry Standard
- ✓ Low Cost
- ✓ Wide Frequency Range
- ✓ "AT" Cut Crystal
- ✓ Excellent Aging
- ✓ Plug in Pins

OPTIONS

- ✓ Tighter Tolerances
- ✓ Extended Temperature Ranges
- ✓ Mylar Spacer
- ✓ Tape and Reel
- ✓ Vinyl Sleeve
- ✓ Third Lead



QUICK DELIVERY!

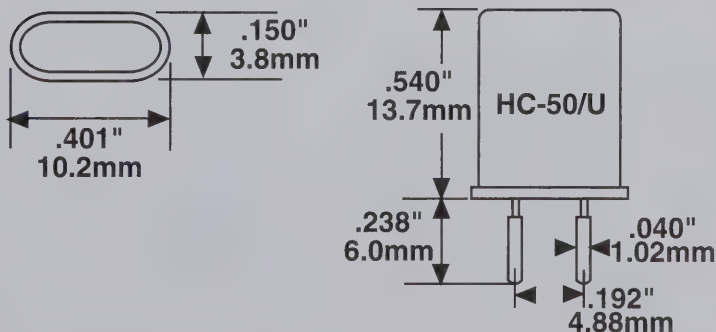
CRYSTALS

HC50U STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|---------------------|-------|---------|-------|
| Frequency Range | | 3.500 | 200.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -30 | +30 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -20°C ~ +70°C | -50 | +50 | PPM |
| Temperature Range | | | | |
| Operating (TOPR) | | -20 | +70 | °C |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 3.500 ~ 200.000 MHz | | 1.0 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

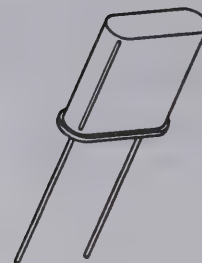
| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 3.500 ~ 3.700 | Fundamental | 120 | 8.000 ~ 10.000 | Fundamental | 35 |
| 3.700 ~ 4.200 | Fundamental | 100 | 10.000 ~ 12.500 | Fundamental | 30 |
| 4.200 ~ 4.900 | Fundamental | 70 | 12.500 ~ 16.000 | Fundamental | 25 |
| 4.900 ~ 5.000 | Fundamental | 55 | 16.000 ~ 25.000 | Fundamental | 20 |
| 5.000 ~ 6.000 | Fundamental | 50 | 16.000 ~ 23.000 | 3rd OT | 60 |
| 6.000 ~ 8.000 | Fundamental | 40 | 23.000 ~ 65.000 | 3rd OT | 40 |
| | | | 60.000 ~ 110.000 | 5th OT | 80 |
| | | | 110.000 ~ 200.000 | 7th OT | 120 |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



LOW FREQUENCY CRYSTAL**HC51U****FEATURES**

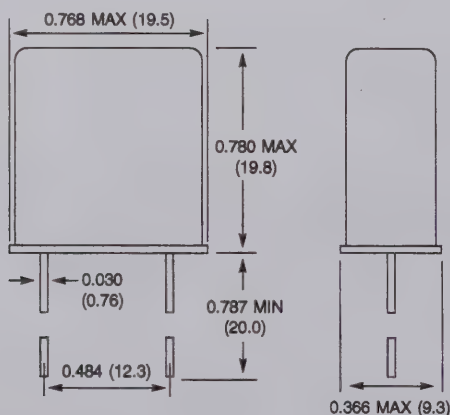
- ✓ Excellent Reliability
- ✓ Low Frequency
- ✓ Third Lead Option

**HC51U STANDARD SPECIFICATIONS***

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|---------------------|-----------|--------|-------|
| Frequency Range | | 100 kHz** | 4.800 | MHz |
| Frequency Tolerance | Ta = 25°C | -50 | +50 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -10°C ~ +60°C | -100 | +100 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -10 | +60 | |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (C0) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 100 kHz ~ 4.800 MHz | | 2.0 | mW |
| Aging | Ta = 25°C; per year | -7.0 | +7.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| 0.100 ~ 0.160 | Fundamental | 5000 | 2.000 ~ 2.400 | Fundamental | 300 |
| 0.160 ~ 0.500 | Fundamental | 3000 | 2.400 ~ 3.000 | Fundamental | 250 |
| 0.500 ~ 0.800 | Fundamental | 3000 | 3.000 ~ 3.200 | Fundamental | 150 |
| 0.800 ~ 1.000 | Fundamental | 2000 | 3.200 ~ 4.000 | Fundamental | 120 |
| 1.000 ~ 1.250 | Fundamental | 800 | 4.000 ~ 4.400 | Fundamental | 80 |
| 1.250 ~ 1.800 | Fundamental | 500 | 4.400 ~ 4.800 | Fundamental | 70 |
| 1.800 ~ 2.000 | Fundamental | 400 | | | |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.

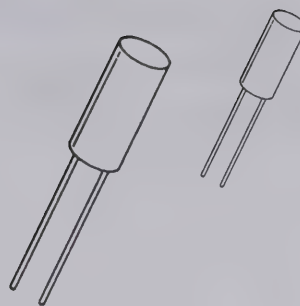


TUNING FORK WATCH CRYSTAL

T26W/T38W

FEATURES

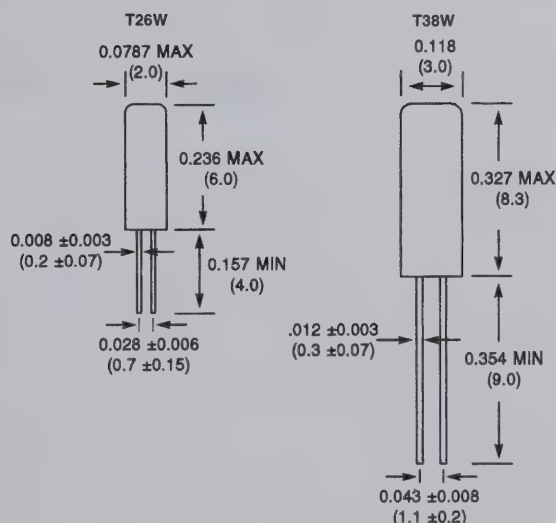
- ✓ Low Cost
- ✓ Miniature Packages
- ✓ Tight Tolerance
- ✓ Cold Weld Design
- ✓ Long Term Stability



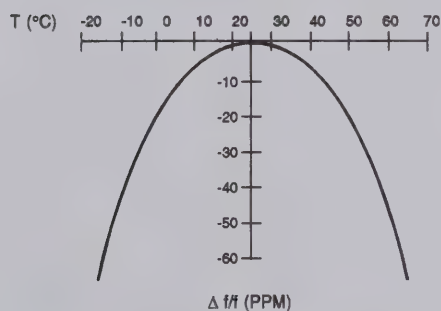
T26W/T38W STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | T26W | | T38W | | UNITS |
|------------------------------------|-----------------------------|------|-------|------|-------|--------------------------|
| | | MIN. | MAX. | MIN. | MAX. | |
| Frequency | 32.768 kHz | | | | | |
| Frequency Tolerance | Ta = 25°C, CL=12.5pF | -20 | +20 | -20 | +20 | PPM |
| Frequency Stability | (K) Temperature Coefficient | | -0.04 | | -0.04 | PPM / (Δ°C) ² |
| Temperature Range | | | | | | °C |
| Turnover (TO) | | +20 | +30 | +20 | +30 | |
| Operating (TOPR) | | -10 | +60 | -10 | +60 | |
| Storage (TSTG) | | -20 | +70 | -20 | +70 | |
| Equivalent Series Resistance (ESR) | | | 50 | | 35 | kΩ |
| Insulation Resistance | 100 VDC | 500 | | 500 | | MΩ |
| Drive Level | | | 1.0 | | 1.0 | μW |
| Aging | Ta = 25°C; per year | -3.0 | +3.0 | -3.0 | +3.0 | PPM |

All specifications subject to change without notice.



PARABOLIC TEMPERATURE CURVE



To determine frequency stability, use parabolic curvature
For example: What is stability at 45°C?

- 1) Change in T (°C) = 45 - 25 = 20°C
- 2) Change in frequency = -0.04 PPM * (ΔT)²
= -0.04 PPM * (20)²
= -16.0 PPM

Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

MICRO MINIATURE CERAMIC SMD CRYSTAL**S75****FEATURES**

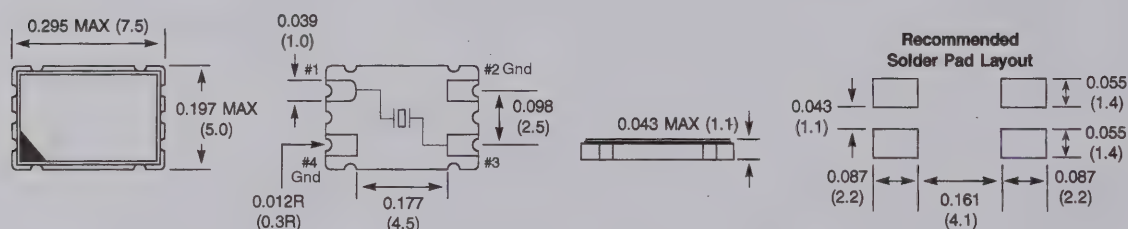
- ✓ Tight Stability Option
- ✓ Tight Tolerance Option
- ✓ Low Profile
- ✓ Wide Frequency Range
- ✓ "AT" Cut Crystal Blank
- ✓ Tape and Reel (3,000 pcs. STD)

**S75 STANDARD SPECIFICATIONS***

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|----------------------|--------|---------|-------|
| Frequency Range | | 9.8304 | 100.000 | MHz |
| Frequency Tolerance | Ta = 25°C | - 50 | + 50 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -10°C ~ +60°C | - 50 | + 50 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -10 | +60 | |
| Storage (TSTG) | | -30 | +85 | |
| Shunt Capacitance (Co) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 9.8304 ~ 100.000 MHz | | 0.5 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| 9.8304 ~ 16.000 | Fundamental | 60 | 28.000 ~ 84.000 | 3rd OT | 60 |
| 16.000 ~ 32.000 | Fundamental | 40 | 84.000 ~ 100.000 | 5th OT | 80 |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



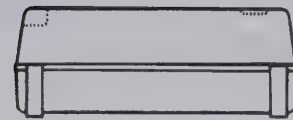
Inch dimensions shall govern.
All dimensions are in inches &
parenthetically in millimeters.



International Crystal Manufacturing, Inc. P.O. Box 26330 • Oklahoma City, OK 73126-0330 • Phone (405) 236-3741
Fax (405) 235-1904 • Toll Free 1-800-725-1426 • 24 Hr. Toll Free Fax 1-800-322-9426 • www.icmfg.com • E-mail freeland@icmfg.com

PLASTIC ENCASED SMD CRYSTAL

SP135



FEATURES

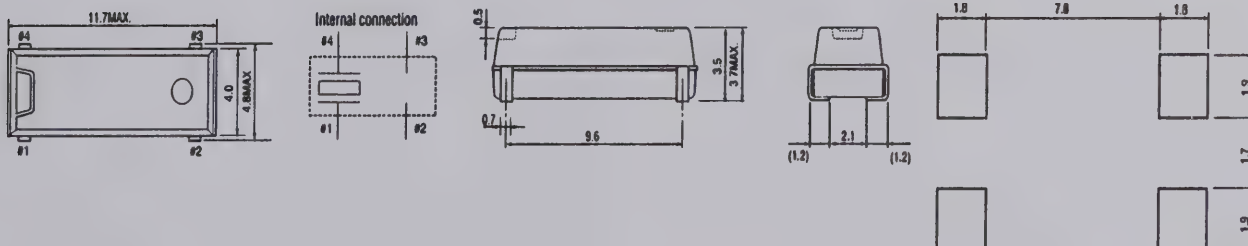
- ✓ High Temperature Seal
- ✓ Space Saving Design
- ✓ Industry Standard
- ✓ Cost Effective
- ✓ Tape and Reel (1,000 pcs. STD)

SP135 STANDARD SPECIFICATIONS*

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|---------------------------------|-----------------------|----------|--------|-------|
| Frequency Range | | 3.579545 | 70.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -50 | +50 | PPM |
| Frequency Stability, ref @ 25°C | Ta = -10°C ~ +70°C | -100 | +100 | PPM |
| Temperature Range | | | | °C |
| Operating (TOPR) | | -10 | +70 | |
| Storage (TSTG) | | -40 | +90 | |
| Shunt Capacitance (C0) | | | 7.0 | pF |
| Load Capacitance (CL) | Customer Specified | 10.0 | Series | pF |
| Drive Level | 3.579545 ~ 70.000 MHz | | 0.1 | mW |
| Aging | Ta = 25°C; per year | -5.0 | +5.0 | PPM |

| FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω | FREQUENCY RANGE (MHz) | OPERATIONAL MODE | MAX ESR Ω |
|-----------------------|------------------|-----------|-----------------------|------------------|-----------|
| 3.579 ~ 4.000 | Fundamental | 200 | 9.000 ~ 13.000 | Fundamental | 60 |
| 4.000 ~ 5.000 | Fundamental | 150 | 13.000 ~ 20.000 | Fundamental | 40 |
| 5.000 ~ 6.000 | Fundamental | 120 | 20.000 ~ 30.000 | Fundamental | 30 |
| 6.000 ~ 7.000 | Fundamental | 100 | 30.000 ~ 70.000 | 3rd OT | 100 |
| 7.000 ~ 9.000 | Fundamental | 80 | | | |

* Other tolerances, stabilities & operating temperature ranges available. Call us for specific requirements.
All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

SURFACE MOUNT WATCH CRYSTAL

SP114

FEATURES

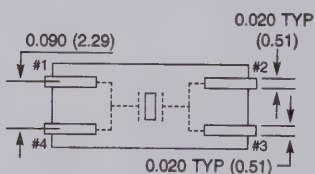
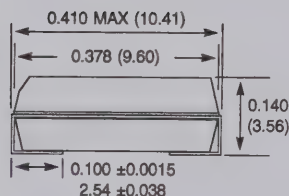
- ✓ Low Profile
- ✓ Small Size
- ✓ Long Term Stability
- ✓ Industry Standard
- ✓ Tape and Reel (2,000 pcs. STD)



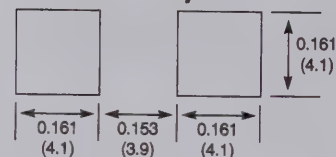
SP114 STANDARD SPECIFICATIONS

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|------------------------------------|-------------------------|------------|-------|--------------------------|
| Frequency | | 32.768 kHz | | |
| Frequency Tolerance | Ta = 25°C, CL=12~5 pF | -20 | +20 | PPM |
| Frequency Stability | Temperature Coefficient | | -0.04 | PPM / (Δ°C) ² |
| Temperature Range | | | | °C |
| Turnover (TO) | | +20 | +30 | |
| Operating (TOPR) | | -40 | +85 | |
| Storage (TSTG) | | -55 | +125 | |
| Equivalent Series Resistance (ESR) | | | 50.0 | kΩ |
| Insulation Resistance | @ 100VDC | 500 | | MΩ |
| Drive Level | | | 1.0 | μW |
| Aging | Ta = 25°C; per year | -3.0 | +3.0 | PPM |

All specifications subject to change without notice.



Recommended Solder Pad Layout



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

MINIATURE SMD TUNING FORK WATCH CRYSTAL

SP94



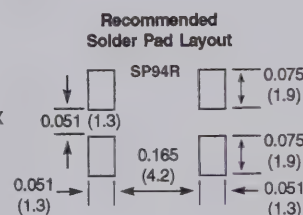
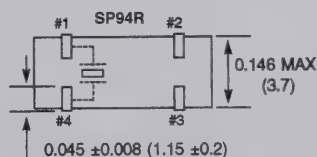
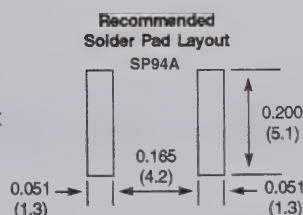
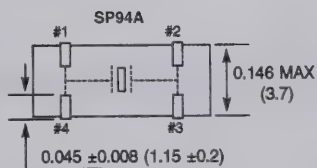
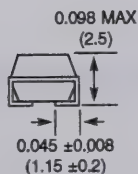
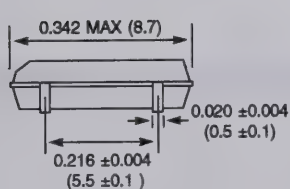
FEATURES

- ✓ Long Term Stability
- ✓ 2.5mm Height
- ✓ Miniature Package
- ✓ Two Pin Connection Types
- ✓ Tape and Reel (3,000 pcs. STD)

SP94 STANDARD SPECIFICATIONS

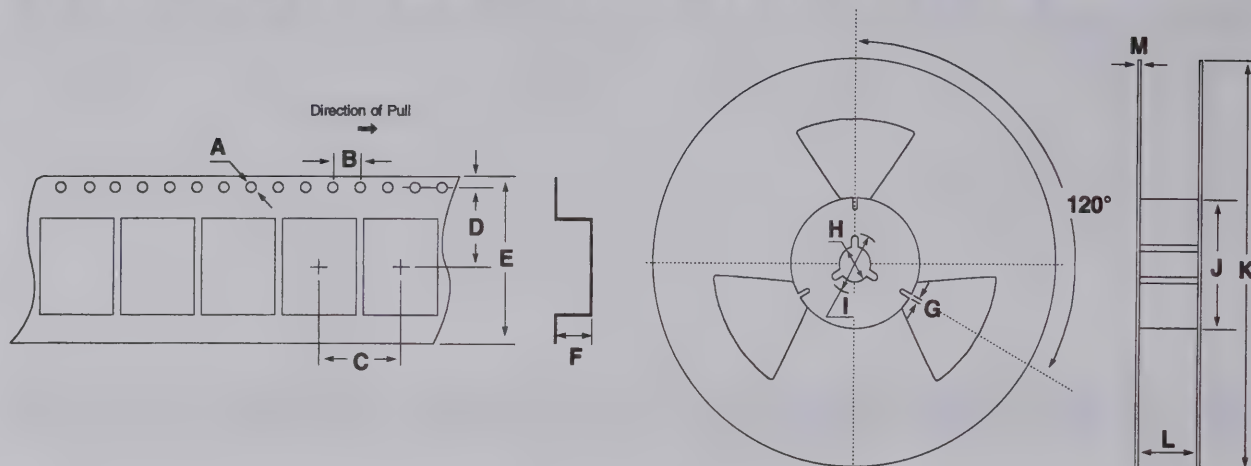
| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|-----------------------------------|-------------------------|------|-------|--------------------------|
| Frequency | 32.768 kHz | | | |
| Frequency Tolerance | Ta = 25°C, CL=12.5 pF | -20 | +20 | PPM |
| Frequency Stability | Temperature Coefficient | | -0.04 | PPM / (Δ°C) ² |
| Temperature Range | | | | °C |
| Turnover (TO) | | +20 | +30 | |
| Operating (TOPR) | | +40 | +85 | |
| Storage (TSTG) | | -55 | +125 | |
| Equivalent Series Resistance (RS) | | | 60.0 | kΩ |
| Insulation Resistance | | 100 | | MΩ |
| Drive Level | | | 1.0 | μW |
| Aging | Ta = 25°C; per year | -3.0 | +3.0 | PPM |

All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

SURFACE MOUNT CRYSTALS TAPE AND REEL SPECIFICATIONS



TAPE SPECIFICATIONS (Millimeters)

| MODEL | A | B | C | D | E | F | STD. QTY* |
|-------|------|-----|------|------|------|-----|-----------|
| S75 | Ø1.5 | 4.0 | 8.0 | 7.5 | 16.0 | 1.7 | 3,000 |
| SP135 | Ø1.5 | 4.0 | 8.0 | 11.5 | 24.0 | 5.5 | 1,000 |
| SP114 | Ø1.5 | 4.0 | 8.0 | 7.5 | 16.0 | 3.9 | 2,000 |
| SP94 | Ø1.5 | 4.0 | 8.0 | 7.5 | 16.0 | 2.7 | 3,000 |
| HC49S | Ø1.5 | 4.0 | 12.0 | 11.5 | 24.0 | 4.8 | 1,000 |

REEL SPECIFICATIONS (Millimeters)

| MODEL | G | H | I | J | K | L | M |
|-------|-----|-----|-----|-----|------|------|-----|
| S75 | 2.0 | Ø13 | Ø21 | Ø80 | Ø250 | 17.5 | 2.0 |
| SP135 | 2.0 | Ø13 | Ø23 | Ø80 | Ø250 | 13.5 | 2.0 |
| SP114 | 2.0 | Ø13 | Ø21 | Ø80 | Ø330 | 17.5 | 2.0 |
| SP94 | 2.0 | Ø13 | Ø21 | Ø50 | Ø330 | 16.4 | 2.0 |
| HC49S | 2.0 | Ø13 | Ø21 | Ø80 | Ø330 | 25.5 | 2.0 |

* Standard reel quantity.

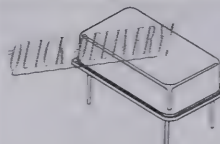
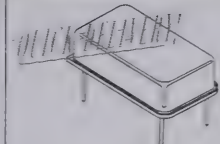
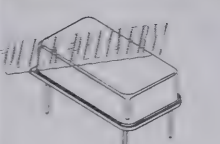
All tape and reel specifications are specified in millimeters.

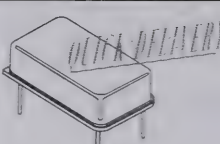

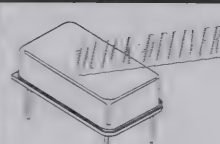
NOTES


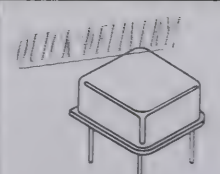
NOTES

CLOCK OSCILLATOR SELECTION GUIDE

THRU-HOLE OSCILLATORS

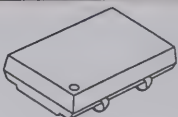
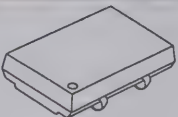

| PRODUCT | IT1100FSS | IT1100FRT | IT1100FRT3S |
|---------------------|--|--|---|
| |  |  |  |
| Frequency Range | 0.032~100.000 MHz | 1.800~80.000 MHz | 1.800~80.000 MHz |
| Frequency Stability | ±100 PPM | ±100 PPM | ±100 PPM |
| Temperature Range | 0°C ~ +70°C | -10°C ~ +70°C | -10°C ~ +70°C |
| Key Features | <ul style="list-style-type: none"> ✓ Industry Standard ✓ Low Cost ✓ Drives Full 10 TTL Load ✓ Wide Frequency Range ✓ Rugged Resistance Weld | <ul style="list-style-type: none"> ✓ 45/55 Symmetry up to 50 MHz ✓ Fast Rise/Fall Times ✓ -40°C to 85°C Option ✓ Low Current Consumption | <ul style="list-style-type: none"> ✓ High Frequency TTL ✓ Fast Rise/Fall Times ✓ 45/55 Symmetry (1.8 ~ 80 MHz) ✓ Tri-state Enable/Disable |
| CATALOG PAGES | PAGE 27 | PAGE 28 | PAGE 29 |

| PRODUCT | IT1100FSS3S | IE1100FRS | IC1100FRSV2 |
|---------------------|---|--|---|
| |  |  |  |
| Frequency Range | 0.032~100.000 MHz | 30.000~200.000 MHz | 4.000~50.000 MHz |
| Frequency Stability | ±100 PPM | ±100 PPM | ±100 PPM |
| Temperature Range | 0°C ~ +70°C | -10°C ~ +70°C | -10°C ~ +70°C |
| Key Features | <ul style="list-style-type: none"> ✓ HCMOS/TTL ✓ Wide Frequency Range ✓ Tri-state Enable/Disable | <ul style="list-style-type: none"> ✓ High Frequency ECL ✓ 10kh Logic Output ✓ Low Noise | <ul style="list-style-type: none"> ✓ Low Power Consumption ✓ Tight Stabilities ✓ Rugged Resistance Weld ✓ Pullability |
| CATALOG PAGES | PAGE 30 | PAGE 31 | PAGE 34 |

| PRODUCT | IT1100HRT3S | IT1100HSS3S | |
|---------------------|--|--|--|
| |  |  | |
| Frequency Range | 1.8000~ 80.000 MHz | 0.032~100.000 MHz | |
| Frequency Stability | ±100 PPM | ±100 PPM | |
| Temperature Range | -10°C ~ +70°C | 0°C ~ +70°C | |
| Key Features | <ul style="list-style-type: none"> ✓ 8 Pin Dip ✓ 15pF HCMOS Load ✓ 10TTL Fanout ✓ Tri-state Enable/Disable ✓ Fast Rise Fall Times | <ul style="list-style-type: none"> ✓ 8 Pin Dip ✓ 15pF HCMOS Load ✓ 10TTL Fanout ✓ Low Cost ✓ Tri-state Enable/Disable | |
| CATALOG PAGES | PAGE 32 | PAGE 33 | |

CLOCK OSCILLATOR SELECTION GUIDE

SURFACE MOUNT OSCILLATORS

| PRODUCT | ISO1410 | ISO1310 | ISO7.505A/B |
|-----------------|---|---|---|
| |  |  |  |
| Freq. Range | 1.025~66.667 MHz | 1.800~67.000 MHz | ISO7.505A 1.800~80.000 MHz ISO7.505B 1.800~50.000 MHz |
| Freq. Stability | ±100 PPM -10 ~ +70°C ±200 PPM -40 ~ +85°C | ±100PPM | ±100 PPM |
| Temp. Range | -10°C ~ +70°C | -10°C ~ +70°C | -10°C ~ +70°C -40°C ~ +85°C Option |
| Key Features | <ul style="list-style-type: none"> ✓ Extended Temp. Range ✓ Solderable ~ 260°C for 10 sec. ✓ Tape and Reel | <ul style="list-style-type: none"> ✓ 50pF /10TTL ✓ Industry Std Footprint ✓ Tri-state Enable/Disable ✓ Fast Rise/Fall Times | <ul style="list-style-type: none"> ✓ Miniature Package ✓ Tri-State Enable/Disable ✓ Available -40° ~ +85°C ✓ 3000 G Shock Resistance ✓ Tape and Reel |

| | | | |
|---------------|---------|---------|---------|
| CATALOG PAGES | PAGE 35 | PAGE 36 | PAGE 37 |
|---------------|---------|---------|---------|

FREQUENCY RANGE BY PRODUCT

| PRODUCT | .360 kHz | 1 MHz | 50 MHz | 70 MHz | 100 MHz | 200 MHz |
|---------------|----------|------------------|--------------------|--------|---------|---------|
| THRU-HOLE | | | | | | |
| IT1100FSS | | .032~100.000 MHz | | | | |
| IT1100FRT | | 1.800~80.000 MHz | | | | |
| IT1100FRT3S | | 1.800~80.000 MHz | | | | |
| IT1100FSS3S | | .032~100.000 MHz | | | | |
| IE1100FRS | | | 30.000~200.000 MHz | | | |
| IC1100FRSV2 | | 4.000~50.000 MHz | | | | |
| IT1100HRT3S | | 1.800~30.000 MHz | | | | |
| IT1100HSS3S | | .032~100.000 MHz | | | | |
| SURFACE MOUNT | | | | | | |
| ISO1410A | | 1.025~66.667 MHz | | | | |
| ISO1310 | | 1.800~67.000 MHz | | | | |
| ISO7.505A | | 1.800~80.000 MHz | | | | |
| ISO7.505B | | 1.800~50.000 MHz | | | | |



TTL/HCMOS CLOCK OSCILLATOR

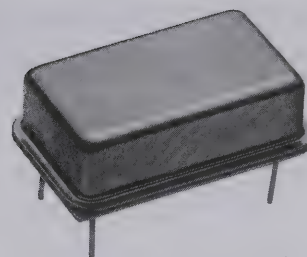
IT1100FSS

FEATURES

- ✓ Low Cost
- ✓ Industry Standard
- ✓ Wide Frequency Range
- ✓ Rugged Resistance Weld
- ✓ Drives Full 10 TTL Load
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|---------------------|-------------|
| ±100 PPM (STD) | IT1100FSS |
| ±50PPM | IT1150FSS |
| ±25PPM | IT1125FSS |



QUICK DELIVERY!

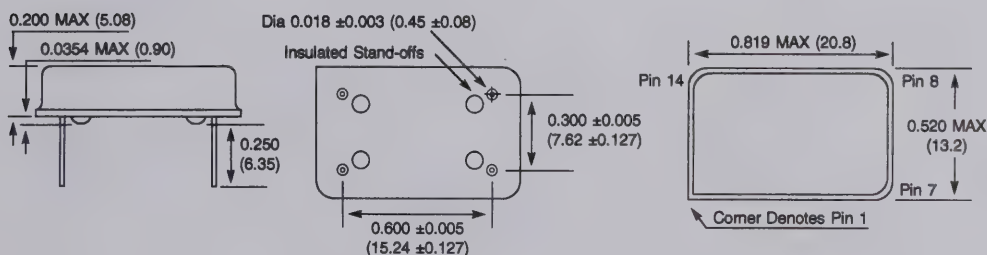
OSCILLATORS

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, RL = 400Ω, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|----------------------|-----------------|------------------------|-------|----------|-----------|
| Frequency Range (Fo) | | | 0.032 | 100.000 | MHz |
| Frequency Stability | 0.032 ~ 100.000 | All Conditions* | -100 | +100 | PPM |
| Temperature Range | 0.032 ~ 100.000 | | | | |
| Operating (TOPR) | | | 0 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | 0.032 ~ 100.000 | | +4.5 | +5.5 | V |
| Input Current (IDD) | 0.032 ~ 100.000 | | | 45 | mA |
| Output Symmetry | 0.032 ~ 100.000 | | 40 | 60 | % |
| Rise Time (TR) | 0.032 ~ 100.000 | | | 6 | nS |
| Fall Time (TF) | 0.032 ~ 100.000 | | | 6 | |
| Output Voltage (VOL) | 0.032 ~ 100.000 | | | 0.5 | V |
| (VOH) | | | | 4.5 | |
| Output Load | 0.032 ~ 100.000 | TTL Load HCMOS Load | | 10 15 | TTL pF |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration. See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.



Pin Connections
 #1 N.C. #8 Output
 #7 GND (Case) #14 +5Vdc

Inch dimensions shall govern.
 All dimensions are in inches &
 parenthetically in millimeters.

TTL/HCMOS CLOCK OSCILLATOR IT1100FRT

FEATURES

- ✓ Fast Rise/Fall Times
- ✓ 45/55% Symmetry up to 50 MHz
- ✓ Low Current Consumption
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|---------------------------|-------------|
| ±100 PPM (STD -10°C~70°C) | IT1100FRT |
| ±50 PPM | IT1150FRT |
| ±25 PPM | IT1125FRT |



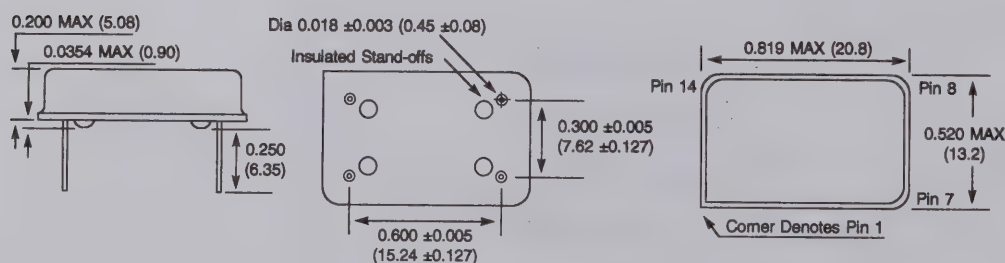
QUICK DELIVERY!

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, RL = noted below, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|----------------------|-----------------|------------------------|-------|----------|-----------|
| Frequency Range (Fo) | | | 1.800 | 80.000 | MHz |
| Frequency Stability | 1.800 ~ 80.000 | All Conditions* | -100 | +100 | PPM |
| Temperature Range | 1.800 ~ 80.000 | | | | |
| Operating (TOPR) | | | -10 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | 1.800 ~ 80.000 | | +4.5 | +5.5 | V |
| Input Current (IDD) | 1.800 ~ 80.000 | | | 45 | mA |
| Output Symmetry | 1.800 ~ 80.000 | 1.4 V Level | 45 | 55 | % |
| Rise Time (TR) | 1.800 ~ 80.000 | 0.5 V to 4.5 V | | 6 | nS |
| Fall Time (TF) | 1.800 ~ 80.000 | 4.5 V to 0.5 V | | 6 | |
| Output Voltage (VOL) | 1.800 ~ 80.000 | | | 0.5 | V |
| (VOH) | 1.800 ~ 80.000 | | | 4.5 | |
| Output Load | 1.800 ~ 80.000 | TTL Load HCMOS Load | | 10 15 | TTL pF |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration
See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.



Pin Connections

#1 N.C. #8 Output
#7 GND (Case) #14 +5 VDC

Inch dimensions shall govern.
All dimensions are in inches &
parenthetically in millimeters.



TTL/HCMOS TRI-STATE HIGH FREQUENCY CLOCK OSCILLATOR

IT1100FRT3S

FEATURES

- ✓ Fast Rise/Fall Times
- ✓ High Frequency TTL
- ✓ Tri-state Enable/Disable
- ✓ 45/55 Symmetry(1.8 ~ 80 MHz)
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|---------------------|-------------|
| ±100 PPM | IT1100FRT3S |
| ±50 PPM | IT1150FRT3S |
| ±25PPM (to 50 MHz) | IT1125FRT3S |



QUICK DELIVERY!

OSCILLATORS

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, RL = 400Ω)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|-------------------------------|-----------------|------------------------|-------|------------|-----------|
| Frequency Range (F0) | | | 1.800 | 80.000 | MHz |
| Frequency Stability | 1.800 ~ 80.000 | All Conditions* | -100 | +100 | PPM |
| Temperature | 1.800 ~ 80.000 | | | | |
| Operating (TOPR) | | | -10 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | 1.800 ~ 80.000 | | +4.5 | +5.5 | V |
| Input Current (IDD) | 1.800 ~ 80.000 | | | 45 | mA |
| Output Symmetry | 1.800 ~ 80.000 | 1.4 V Level | 45 | 55 | % |
| Rise Time (TR) | 1.800 ~ 80.000 | 0.5 V to 4.5 V | | 6 | nS |
| Fall Time (TF) | | 4.5 V to 0.5 V | | 6 | |
| Output Voltage (VOL) (VOH) | 1.800 ~ 80.000 | | | 0.5 4.5 | V |
| Output Load | 1.800 ~ 80.000 | TTL Load HCMOS Load | | 10 15 | TTL pF |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

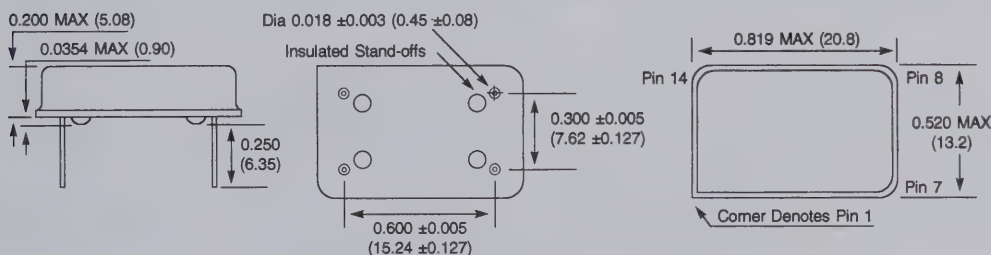
***An internal pullup resistor from pin 1 to pin 14 allows active output if pin 1 is left open.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 8) |
|-----------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH ≥ 2.2 V | ACTIVE |
| '0' Level VIL ≥ 0.8 V | High Z |



Pin Connections

- #1 E/D **
- #7 GND (Case)
- #8 Output
- #14 +5Vdc

Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.

TTL/HCMOS TRI-STATE OSCILLATOR IT1100FSS3S

FEATURES

- ✓ HCMOS/TTL
- ✓ Wide Frequency Range
- ✓ Tri-state Enable/Disable
- ✓ Industry Standard Footprint
- ✓ Grounded metal cover reduces EMI
- ✓ Internal Bypass Capacitors - no external components required
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|---------------------|-------------|
| ±100 PPM | IT1100FSS3S |
| ±50 PPM | IT1150FSS3S |
| ±25PPM | IT1125FSS3S |



QUICK DELIVERY!

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = Max load)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|----------------------|------------------|------------------------|-------|----------|-----------|
| Frequency Range (Fo) | | | 0.032 | 100.000 | MHz |
| Frequency Stability | 0.032 ~ 100.000* | All Conditions * | -100 | +100 | PPM |
| Temperature Range | | | | | |
| Operating (TOPR) | 0.032 ~ 100.000* | | 0 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | 0.032 ~ 100.000* | | +4.5 | +5.5 | V |
| Input Current (IDD) | 0.032 ~ 100.000* | | | 45 | mA |
| Output Symmetry | 0.032 ~ 100.000* | 2.5V | 40 | 60 | % |
| Rise Time (TR) | 0.032 ~ 100.000* | 0.5V ~ 4.5V | | 6 | nS |
| Fall Time (TF) | | 4.5V ~ 0.5V | | 6 | |
| Output Voltage (VOL) | 0.032 ~ 100.000* | | | 0.5 | V |
| | | | | 4.5 | |
| Output Load | 0.032 ~ 100.000* | TTL Load HCMOS Load | | 10 15 | TTL pF |

* 90 MHz to 135 MHz available based on load, temperature range and VDD.
Please contact ICM for frequencies in this range.

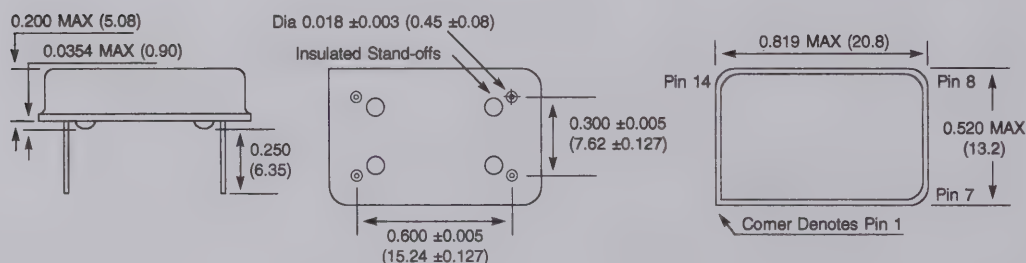
***An internal pullup resistor from pin 1 to pin 14 allows active output if pin 1 is floating.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| | |
|-------------|----------------|
| INH (Pin 1) | OUTPUT (Pin 8) |
| N.C. *** | ACTIVE |
| VIH ≤ 2.0 V | ACTIVE |
| VIL ≥ 0.8 V | High Z |



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Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.



14 PIN DIP ECL OSCILLATOR

IE1100FRS

FEATURES

- ✓ 10 KH Logic Output
- ✓ High Frequency Range
- ✓ Low Noise

OPTIONS

- ✓ Pullup/Down Internal Resistors
- ✓ Various Pin Connections
- ✓ Complementary Output
- ✓ ± 50 PPM (IE1150FRS Series)
- ✓ ± 25 PPM (IE1125FRS Series)



ELECTRICAL CHARACTERISTICS ($T_a = -10 \sim 70^\circ\text{C}$, $V_{EE} = 5.2 \text{ V} \pm 5\%^{**}$, $V_{TT} = 2.0 \text{ V}^{**}$ $R_T = 50\Omega^{**}$)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|---|---------------------------------------|--|----------------|----------------------|------------------|
| Frequency Range (Fo) | | | 30.000 | 200.000 | MHz |
| Frequency Stability | 30.000 ~ 200.000 | All Conditions* | -100 | +100 | PPM |
| Temperature Range Operating (TOPR) Storage (TSTG) | | | -10 -55 | +70 +125 | $^\circ\text{C}$ |
| Supply Voltage (V_{EE}) | | | -5.46 | -4.94 | V^{**} |
| Input Current (I_{DD}) | 30.000 ~ 170.000 170.000 ~ 200.000 | NOE, NOF, COE, COF NOE, NOF, COE, COF | | 40 50 50 60 | mA |
| Output Symmetry | 30.000 ~ 200.000 | 50% Vp-p Level | 40 | 60 | % |
| Rise Time (T_R) | 30.000 ~ 170.000 170.000 ~ 200.000 | 20% Vp-p ~ 80% Vp-p Level | | 2.0 1.5 | nS |
| Fall Time (T_F) | 30.000 ~ 170.000 170.000 ~ 200.000 | 80% Vp-p ~ 20% Vp-p Level | | 2.0 1.5 | nS |
| Output Voltage (V_{OL}) | 30.000 ~ 200.000 | '0' Logic Level NOE, NOF, COE, COF | -1.95 +3.05 | -1.60 +3.42 | V |
| (V_{OH}) | 30.000 ~ 200.000 | '1' Logic Level NOE, NOF, COE, COF | -1.00 +4.00 | -0.75 +4.45 | V |
| Output Load | 30.000 ~ 200.000 | ECL Load | | 5 | Gates |
| Overlap Time | 30.000 ~ 200.000 | 50% Vp-p (Complementary only) | | 0.5 | nS |
| Start-up Time (T_S) | 30.000 ~ 200.000 | | | 10 | mS |

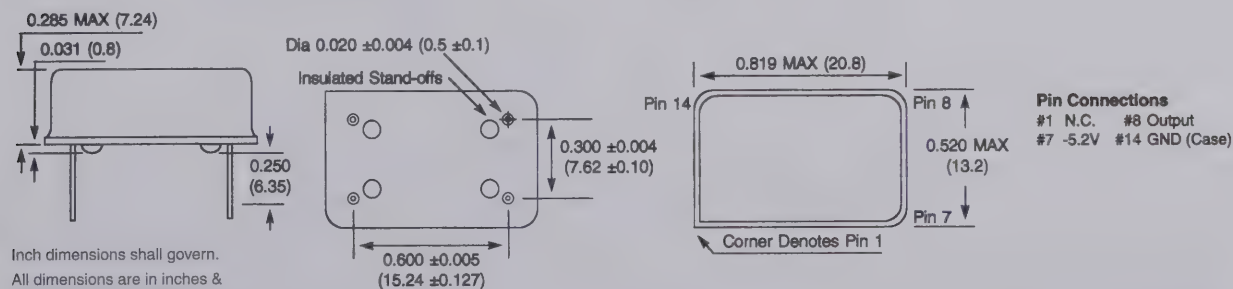
PART NUMBER SELECTION / PIN CONNECTIONS

| Single Output | | | | | | Complementary Output | | | | | |
|---------------|-------|-------|--------|--------|----------|----------------------|----------|-------|----------|--------|----------|
| Part# | Pin 1 | Pin 7 | Pin 8 | Pin 14 | Resistor | Part# | Pin 1 | Pin 7 | Pin 8 | Pin 14 | Resistor |
| IE1100FRSNOA | NC | GND | OUTPUT | -5.2V | Down [a] | IE1100FRSCOA | OUTPUT 1 | GND | OUTPUT 2 | -5.2V | Down [a] |
| IE1100FRSNOB | NC | GND | OUTPUT | -5.2V | None | IE1100FRSCOB | OUTPUT 1 | GND | OUTPUT 2 | -5.2V | None |
| IE1100FRSNOC | NC | -5.2V | OUTPUT | GND | Down [a] | IE1100FRSCOC | OUTPUT 1 | -5.2V | OUTPUT 2 | GND | Down [a] |
| IE1100FRSNOD | NC | -5.2V | OUTPUT | GND | None | IE1100FRSCOD | OUTPUT 1 | -5.2V | OUTPUT 2 | GND | None |
| IE1100FRSNOE | NC | GND | OUTPUT | +5.0V | Up [a] | IE1100FRSCOE | OUTPUT 1 | GND | OUTPUT 2 | +5.0V | Up [a] |
| IE1100FRSNOF | NC | GND | OUTPUT | +5.0V | None | IE1100FRSCOF | OUTPUT 1 | GND | OUTPUT 2 | +5.0V | None |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

[a] up to 1 70MHZ

** IE1100FRSNOF, IE1100FRSNOE $V_{CC} = 5.0 \text{ V} \pm 0.25 \text{ V}$. Consult factory for test circuitry.
See page 39 for environmental/mechanical specifications, test circuits, and output waveform.
All specifications subject to change without notice.



Inch dimensions shall govern.
All dimensions are in inches & parenthetically in millimeters.

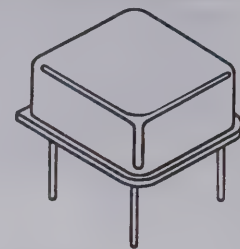
HALF SIZE TTL/HCMOS TRI-STATE ENABLE/DISABLE OSCILLATOR IT1100HRT3S

FEATURES

- ✓ 10 TTL Fanout
- ✓ 8 Pin Dip
- ✓ 15 pF HCMOS Load
- ✓ Tri-state Enable/Disable
- ✓ Fast Rise/Fall Times
- ✓ 45/55 Symmetry (To 80 MHz)
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|-----------------------|-------------|
| ±100 PPM | IT1100HRT3S |
| ±50 PPM | IT1150HRT3S |
| ±25PPM (up to 50 MHz) | IT1125HRT3S |



QUICK DELIVERY!

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|---|-----------------|----------------------------|-------------|-------------|-----------|
| Frequency Range (Fo) | | | 1.800 | 80.000 | MHz |
| Frequency Stability | 1.800 ~ 80.000 | All Conditions * | -100 | +100 | PPM |
| Temperature Range Operating (TOPR) Storage (TSTG) | 1.800 ~ 80.000 | | - 10 -55 | +70 +125 | °C |
| Supply Voltage (VDD) | 1.800 ~ 80.000 | | +4.5 | +5.5 | V |
| Input Current (IDD) | 1.800 ~ 80.000 | | | 45 | mA |
| Output Symmetry | 1.800 ~ 80.000 | 1.4V Level | 45 | 55 | % |
| Rise Time (TR) Fall Time (TF) | 1.800 ~ 80.000 | 0.5V ~ 4.5V 4.5V ~ 0.5V | | 6 | nS |
| Output Voltage (VOL) (VOH) | 1.800 ~ 80.000 | | | 0.5 4.5 | V |
| Output Load | 1.800 ~ 80.000 | TTL HCMOS | | 10 15 | TTL pF |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

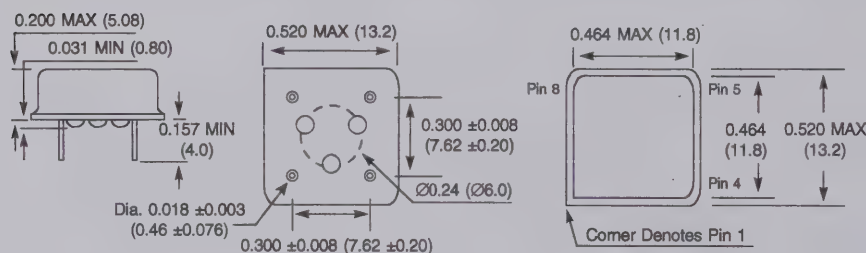
***An internal pullup resistor from pin 1 to pin 8 allows active output if pin 1 is left open.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 5) |
|-----------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH ≤ 2.2 V | ACTIVE |
| '0' Level VIL ≥ 0.8 V | High Z |



Inch dimensions shall govern.
 All dimensions are in inches &
 parenthetically in millimeters.



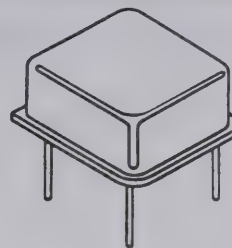
HALF SIZE TTL/HCMOS TRI-STATE ENABLE/DISABLE OSCILLATOR IT1100HSS3S

FEATURES

- ✓ 15pF HCMOS Load
- ✓ Low Cost
- ✓ 10TTL Loads
- ✓ 8 Pin Dip
- ✓ Tri-state Enable/Disable
- ✓ Optional +3.3 VDC Supply

PART NUMBER SELECTION

| Frequency Stability | Part Number |
|---------------------|-------------|
| ±100 PPM | IT1100HSS3S |
| ±50 PPM | IT1150HSS3S |
| ±25PPM | IT1125HSS3S |



QUICK DELIVERY!

OSCILLATORS

ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|-------------------------------|-----------------|-----------------|-------|------------|-----------|
| Frequency Range (Fo) | | | 0.032 | 100.000 | MHz |
| Frequency Stability | 0.032 ~ 100.000 | All Conditions* | -100 | +100 | PPM |
| Temperature Range | | | | | |
| Operating (TOPR) | | | 0 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | | | +4.5 | +5.5 | V |
| Input Current (IDD) | 0.032 ~ 100.000 | | | 45 | mA |
| Output Symmetry | 0.032 ~ 100.000 | 2.5V | 40 | 60 | % |
| Rise Time (TR) | 0.032 ~ 100.000 | 0.5V ~ 4.5V | | 6 | nS |
| Fall Time (TF) | 0.032 ~ 100.000 | 4.5V ~ 0.5V | | 6 | |
| Output Voltage (VOL) (VOH) | 0.032 ~ 100.000 | | | 0.5 4.5 | V |
| Output Load | 0.032 ~ 100.000 | TTL HCMOS | | 10 15 | TTL pF |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

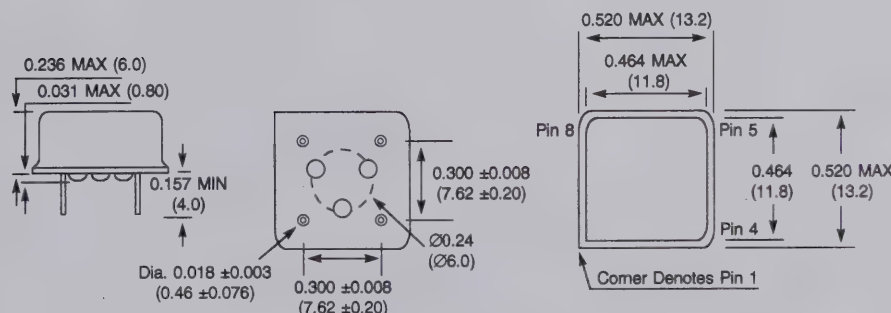
***An internal pullup resistor from pin 1 to pin 8 allows active output if pin 1 is left open.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 5) |
|---------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH 2.2 V | ACTIVE |
| '0' Level VIL 0.8 V | High Z |



Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.

VOLTAGE CONTROLLED CRYSTAL OSCILLATOR

IC1100FRSV2

FEATURES

- ✓ Low Power Consumption
- ✓ Tight Stabilities
- ✓ Rugged Resistance Weld
- ✓ HCMOS/TTL Output
- ✓ Pullability

PART NUMBER SELECTION

| Parts * | Stability (MAX) * | Pullability (MIN) Vc = 2.5 ±2V |
|-------------|-------------------|--------------------------------|
| IC1100FRSV2 | ±100 PPM | ±150 |
| IC1150FRSV2 | ±50 PPM | ±150 |
| IC1150FRSV1 | ±50 PPM | ±100 |
| IC1125FRSV1 | ±25 PPM | ±100 |
| IC1120FRSV5 | ±20 PPM | ±50 |



QUICK DELIVERY!

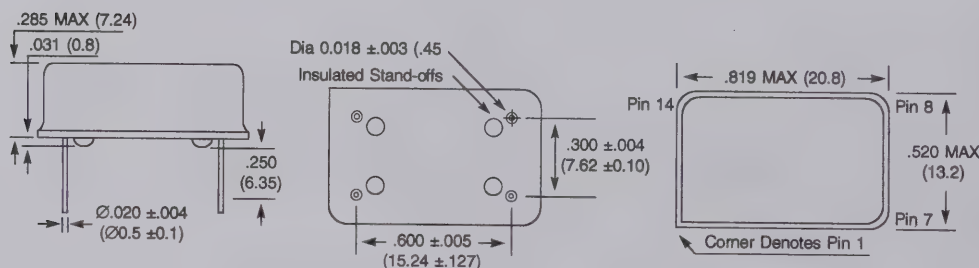
ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|--------------------------------|-----------------|-----------------|-------|--------|-------|
| Frequency Range (Fo) | | | 4.000 | 50.000 | MHz |
| Temperature Range | | | | | |
| Operating (TOPR) | 4.000 ~ 50.000 | | -10 | +70 | °C |
| Storage (TSTG) | | | -30 | +85 | |
| Supply Voltage (VDD) | 4.000 ~ 50.000 | | +4.75 | +5.25 | V |
| Control Voltage (Vc) | 4.000 ~ 50.000 | | +0.5 | +4.5 | V |
| Input Current (IDD) | 4.000 ~ 50.000 | | | 25 | mA |
| Output Symmetry | 4.000 ~ 50.000 | 2.5V | 40 | 60 | % |
| Rise Time (TR) | 4.000 ~ 50.000 | 1.0V ~ 4.0V | | 10 | nS |
| Fall Time (TF) | | 4.0V ~ 1.0V | | 10 | |
| Output Voltage (VOL) | 4.000 ~ 50.000 | IOL = 3.2 mA | | 0.5 | V |
| (VOH) | | IOH = -1 mA | 4.5 | | |
| Output Load | 4.000 ~ 50.000 | TTL Load | | 10 | TTL |
| | 4.000 ~ 50.000 | HCMOS Load | | 15 | pF |
| Start-up Time (Ts) | 4.000 ~ 50.000 | | | 10 | mS |
| Frequency Stability vs Voltage | 4.000 ~ 50.000 | VDD = 5.0V ±10% | -3.0 | +3.0 | PPM |
| Modulation Bandwidth | 4.000 ~ 50.000 | | | 20 | kHz |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, vibration, and Vc = 2.5V.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.



Pin Connections
 #1 Vc #8 Output
 #7 GND #14 +5Vdc

Inch dimensions shall govern.
 All dimensions are in inches & parenthetically in millimeters.

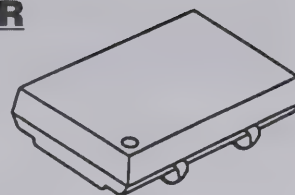


SURFACE MOUNT HCMOS CLOCK OSCILLATOR

ISO1410

FEATURES

- ✓ Extended Temperature Range
- ✓ Tape and Reel (1,000 pcs. STD)
- ✓ Solderable @ 260° for 10 sec.



ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = 15pF)

| PARAMETERS | CONDITIONS | ISO1410A | | ISO1410B | | ISO1410C | | UNITS |
|-------------------------------|---------------------------------|--------------|--------------|--------------|--------------|-----------|-------------|-----------|
| | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| Frequency Range | | 1.025 | 26.000 | 26.000 | 66.667 | 26.000 | 66.667 | MHz |
| Frequency Stability * | -10°C ~ +70°C -40°C ~ +85°C | -100 -200 | +100 +200 | -100 -200 | +100 +200 | -100 - | +100 - | PPM |
| Temperature Range | | | | | | | | |
| Operating (TOPR) | | -10 | +70 | -10 | +70 | -10 | +70 | °C |
| Storage (TSTG) | | -55 | +125 | -55 | +125 | -55 | +125 | |
| Supply Voltage (VDD) | | +4.5 | +5.5 | +4.5 | +5.5 | +4.5 | +5.5 | V |
| Input Current (IDD) | No Load Output Disabled (Iz) | | 23 12 | | 35 28 | | 35 20 | mA |
| Output Symmetry | 2.5V 1.4V | 40 45 | 60 55 | - 45 | - 55 | 40 - | 60 - | % |
| Rise Time (TR) | 1.0V ~ 4.0V 0.4V ~ 2.4V | | 8 8 | | 5 5 | | 7 7 | nS |
| Fall Time (TF) | 4.0V ~ 1.0V 2.4V ~ 0.4V | | 8 8 | | 5 5 | | 7 7 | |
| Output Voltage (VOL) (VOH) | IOL = MAX IOH = MAX | 4.6 | 0.4 | 2.4 | 0.4 | 4.6 | 0.4 | V |
| Output Current (IOL) (IOH) | VOL = MAX VOH = MIN | | 16 -0.4 | | 8 -0.4 | | 4.0 -4.0 | mA |
| Output Load | HCMOS TTL | | 50 10 | | 5 | | 50 | pF TTL |
| Start-up Time (TS) | | | 4 | | 10 | | 10 | mS |
| Output Enable/Disable Time | | | 100 | | 100 | | 100 | nS |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

***An internal pullup resistor from pin 1 to pin 4 allows active output if pin 1 is left open.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

Note: ±50 PPM frequency stability at -10 to +70°C also available.

Note: A 0.01 µF bypass capacitor should be placed between VDD (Pin 4) and GND (Pin 2) to minimize power supply line noise.

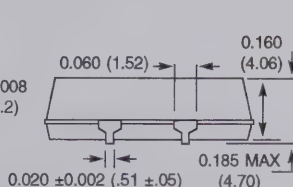
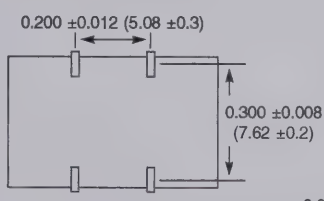
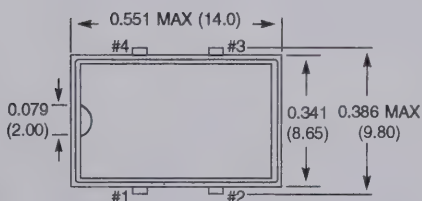
All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 5) |
|----------------------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH 2.0 V (ISO1410A/C) | ACTIVE |
| '1' Level VIH 3.5 V (ISO1410B) | |
| '0' Level VIL 0.8 V (ISO1410A/C) | High Z |
| '0' Level VIL 1.5 V (ISO1410B) | |

Pin Connections

- #1 E/D** #3 Output
#2 GND #4 +5Vdc



Recommended Solder Pad Layout

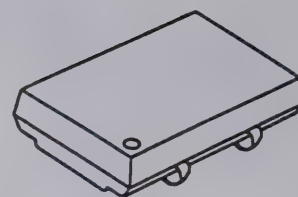


SURFACE MOUNT HCMOS/TTL OSCILLATORS

ISO1310

FEATURES

- ✓ Available in -40° C to +85° C (ISO1310E)
- ✓ Industry Standard Footprint
- ✓ 50 pF / 10 TTL
- ✓ Fast Rise/Fall Times
- ✓ Tri-state Enable/Disable
- ✓ Tape and Reel (1,000 pcs. STD)



ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = 15pF)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | MIN. | MAX. | UNITS |
|-------------------------------|--|-----------------------------|----------|----------------|-----------|
| Frequency Range (Fo) | | | 1.800 | 67.000 | MHz |
| Frequency Stability | 1.800 ~ 67.000 | All Conditions * | -100 | +100 | PPM |
| Temperature Range | 1.800 ~ 67.000 | | | | |
| Operating (TOPR) | | | -10 | +70 | °C |
| Storage (TSTG) | | | -55 | +125 | |
| Supply Voltage (VDD) | 1.800 ~ 67.000 | | +4.5 | +5.5 | V |
| Input Current (IDD) | 1.800 ~ 32.000 32.000 ~ 50.000 50.000 ~ 67.000 | | | 27 45 60 | mA |
| Output Symmetry | 1.800 ~ 50.000 50.000 ~ 67.000 | 2.5V | 45 40 | 55 60 | % |
| Rise Time (TR) | 1.800 ~ 67.000 | 0.5V to 4.5V | | 7 | nS |
| Fall Time (TF) | | 4.5V to 0.5V | | 7 | |
| Output Voltage (VOL) (VOH) | 1.800 ~ 67.000 | IOL = 16 mA IOH = -16 mA | 4.5 | 0.5 | V |
| Output Current (IOL) (IOH) | 1.800 ~ 67.000 | VOH = 0.5 V VOL = 4.5 V | | 16 -16 | mA |
| Output Load | 1.800 ~ 67.000 | TTL HCMOS | | 10 50 | TTL pF |
| Start-up Time (TS) | 1.800 ~ 67.000 | | | 10 | mS |
| Enable/Disable Time | 1.800 ~ 67.000 | | | 100 | nS |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

*** An internal pullup resistor from pin 1 to pin 4 allows active output if pin 1 is left open.

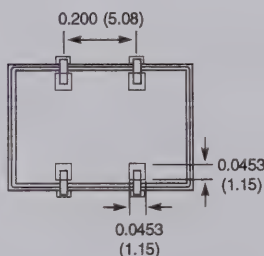
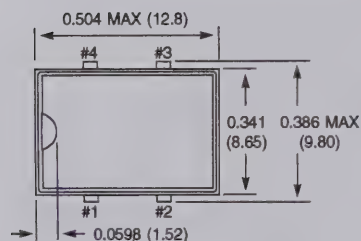
Note: A 0.01 µF bypass capacitor should be placed between VDD (Pin 4) and GND (Pin 2) to minimize power supply line noise.

See page 392 for environmental/mechanical specifications, test circuits, and output waveform.

All specifications subject to change without notice.

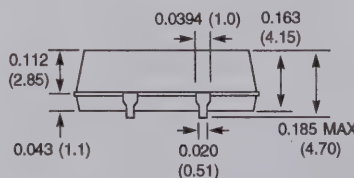
ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 3) |
|-----------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH ≤ 2.2 V | ACTIVE |
| '0' Level VIL ≥ 0.8 V | High Z |



Pin Connections

- #1 E/D **
- #2 GND
- #3 Output
- #4 +5Vdc



Recommended Solder Pad Layout



Inch dimensions shall govern.

All dimensions are in inches and parenthetically in millimeters.



MINIATURE SMD HCMOS OSCILLATOR

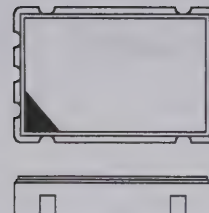
ISO7.505

FEATURES

- ✓ Miniature Package
- ✓ Available -40°C ~ +85°C
- ✓ 3000 G Shock Resistance
- ✓ Tri-State Enable/Disable
- ✓ Tape and Reel (2,000 pcs. STD)

PART NUMBER SELECTION

| Frequency Stability | Part Number | |
|-------------------------|-------------|-------------|
| ±100 PPM -10°C to +70°C | ISO7.505A | ISO7.505B |
| ±100 PPM -40°C to +85°C | ISO7.505AE | ISO7.505BE |
| ±50 PPM (up to 50 MHz) | ISO7.505A50 | ISO7.505B50 |
| ±25 PPM (up to 50 MHz) | ISO7.505A25 | ISO7.505B25 |



ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = 5.0 V, CL = Max load)

| PARAMETERS | FREQUENCY RANGE | CONDITIONS | ISO7.505A | | ISO7.505B | | UNITS |
|---|---|--|------------|----------------------|------------|---------------|-----------|
| | | | MIN. | MAX. | MIN. | MAX. | |
| Frequency Range (Fo) | | | 1.800 | 80.000 | 1.800 | 50.000 | MHz |
| Frequency Stability | | All Conditions* | -100 | +100 | -100 | +100 | PPM |
| Temperature Range Operating (TOPR) Storage (TSTG) | | | -10 -55 | +70 +125 | -10 -55 | +70 +125 | °C |
| Supply Voltage (VDD) | | | +4.5 | +5.5 | +4.5 | +5.5 | V |
| Input Current (IDD) | 1.800 ~ 25.000 25.000 ~ 50.000 50.000 ~ 67.000 67.000 ~ 80.000 | | | 25 45 60 73 | | 20 35 - | mA |
| Output Symmetry | 1.800 ~ 80.000 | 2.5V | 45 | 55 | 45 | 55 | % |
| Rise Time (TR) Fall Time (TF) | 1.800 ~ 80.000 | 0.5V to 4.5V 4.5V to 0.5V | | 7 7 | | 10 10 | nS |
| Output Voltage (VOL) (VOH) | 1.800 ~ 80.000 | IOL = 16 mA / IOH = 4 mA IOH = -16 mA / IOL -4 mA | 4.5 | 0.5 | 4.5 | 0.5 | V |
| Output Current (IOL) (IOH) | 1.800 ~ 80.000 | VOL = 0.5V VOH = 4.5V | | 16 -16 | | 4 -4 | mA |
| Output Load | 1.800 ~ 80.000 | TTL HCMOS | | 10 50 | | 10 LS 15 | TTL pF |
| Start-up Time(TS) | 1.800 ~ 80.000 | | | 10 | | 10 | mS |
| Enable/Disable Time | 1.800 ~ 80.000 | | | 100 | | 100 | nS |

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock, and vibration.

*** An internal pullup resistor from pin 1 to pin 4 allows active output if pin 1 is left open.

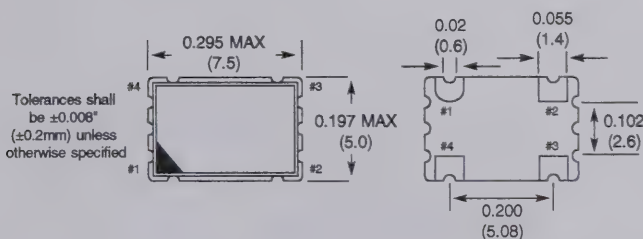
Note: A 0.01, μ F bypass capacitor should be placed between VDD (Pin 4) and GND (Pin 2) to minimize power supply line noise.

See page 39 for environmental/mechanical specifications, test circuits, and output waveform.

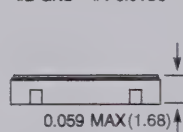
All specifications subject to change without notice.

ENABLE / DISABLE FUNCTION**

| INH (Pin 1) | OUTPUT (Pin 3) |
|----------------------------|----------------|
| OPEN *** | ACTIVE |
| '1' Level VIH \leq 2.2 V | ACTIVE |
| '0' Level VIL \geq 0.8 V | High Z |



Pin Connections
#1 E/D** #3 Output
#2 GND #4 5.0VDC



Recommended Solder Pad Layout

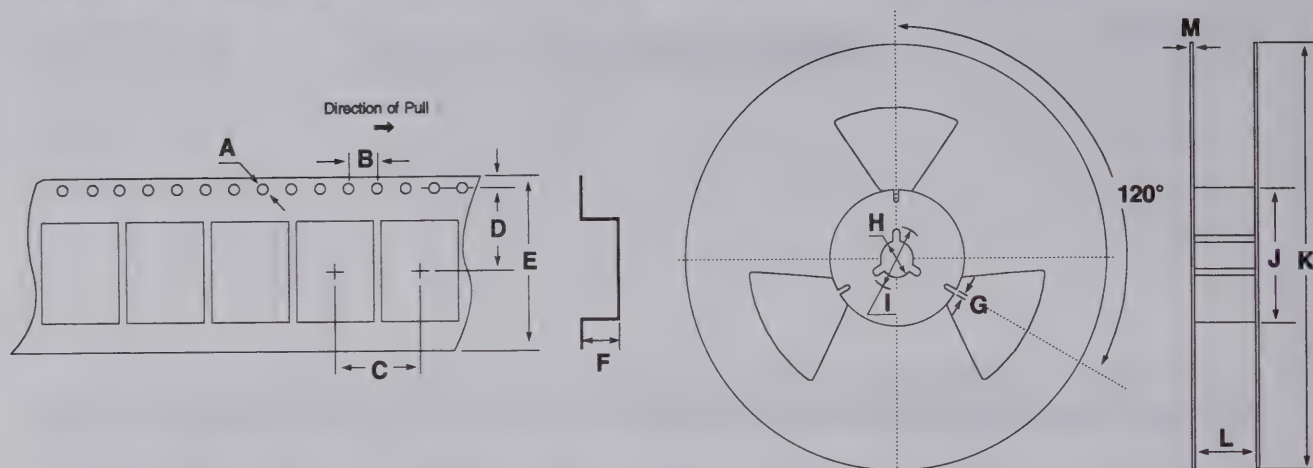


Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.

See page 40 for tape and reel specifications.

SURFACE MOUNT OSCILLATORS TAPE AND REEL SPECIFICATIONS



| MODEL | A | B | C | D | E | F | STD QTY * |
|------------|------|-----|------|------|------|------|-----------|
| ISO1410 | Ø1.5 | 4.0 | 12.0 | 11.5 | 24.0 | 4.8 | 1,000 |
| ISO1310 | Ø1.5 | 4.0 | 12.0 | 11.5 | 24.0 | 5.2 | 1,000 |
| ISO7.505 | Ø1.5 | 4.0 | 8.0 | 7.5 | 16.0 | 2.15 | 2,000 |
| ISTCX01110 | Ø1.5 | 4.0 | 16.0 | 11.5 | 24.0 | 4.4 | 1,000 |

| MODEL | G | H | I | J | K | L | M |
|------------|-----|-----|-----|-----|------|------|-----|
| ISO1410 | 2.0 | Ø13 | Ø21 | Ø80 | Ø330 | 25.5 | 2.0 |
| ISO1310 | 2.0 | Ø13 | Ø21 | Ø80 | Ø250 | 25.5 | 2.0 |
| ISO7.505 | 2.0 | Ø13 | Ø21 | Ø80 | Ø250 | 17.5 | 2.0 |
| ISTCX01110 | 3.0 | Ø13 | Ø21 | Ø80 | Ø330 | 24.4 | 3.0 |

* Standard reel quantity.

Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.

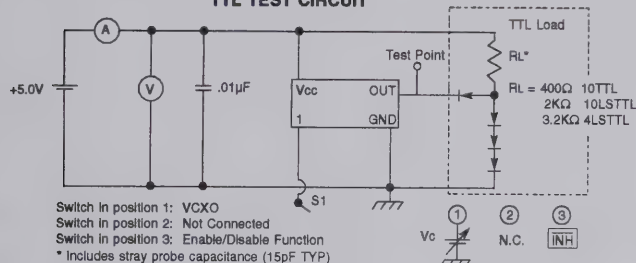


CLOCK OSCILLATOR GENERAL CHARACTERISTICS

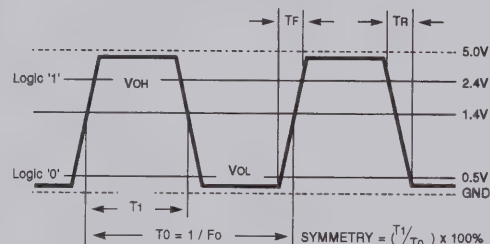
ENVIRONMENTAL/MECHANICAL SPECIFICATIONS

| | |
|-----------------------------|---|
| Gross Leak Test | All units 100% leak tested in Fluorinert FC-43. |
| Hermetically Sealed Package | Mass spectrometer leak rate less than 2×10^{-8} Atm. CC/sec. of helium. |
| Seal Strength | 2.27 Kg max. force perpendicular to top and bottom. |
| Bend Test (Pin Material) | Will withstand maximum bend of 90°, referenced to base, for 2 bends. (Iron and Nickel - Nickel coated, solder dipped.) |
| Solvent Resistance | Isopropyl Alcohol, Trichloroethane Note 1 - Ultrasonic cleaning not to be used. Note 2 - Unit can be cleaned in only one solvent listed. |
| Marking Ink | Epoxy, heat cured |
| Solderability | The terminals are considered solderable and acceptable for electrical connection if 95% of the cooled solder surface is uniform and free from breaks and pinholes. The other 5% of the cooled solder surface may show only pinholes, voids, or rough spots that are not concentrated in one area. |
| Maximum Soldering Temp. | 270°C for 10 seconds on leads. |
| Shock Test | 1000 G's, 0.35 ms, 1/2 sine wave, 3 shocks each plane |
| Vibration Test | 10-55 Hz, 0.060" D. A., 55-2000 Hz, 20 G's, duration time 6 hours |
| Temperature Cycle | 20 cycles from -55°C to +125°C, 1 hour per cycle, 25°C ref |

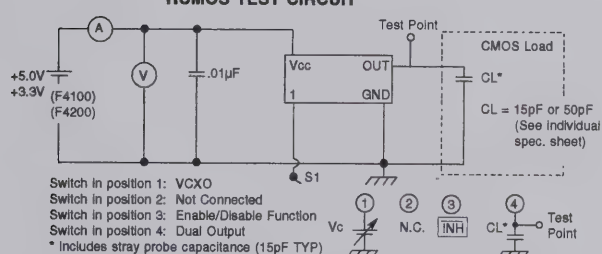
TTL TEST CIRCUIT



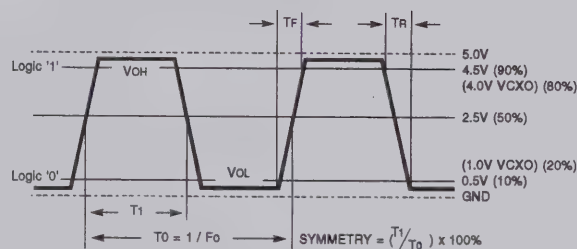
TTL WAVEFORM



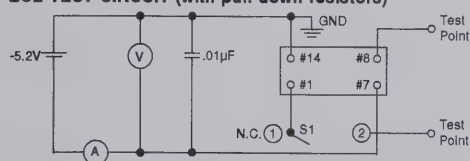
HCMOS TEST CIRCUIT



HCMOS WAVEFORM

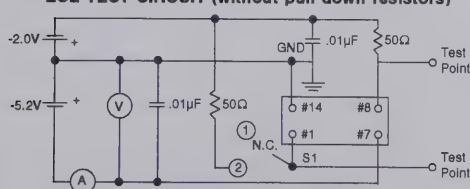


ECL TEST CIRCUIT (with pull down resistors)



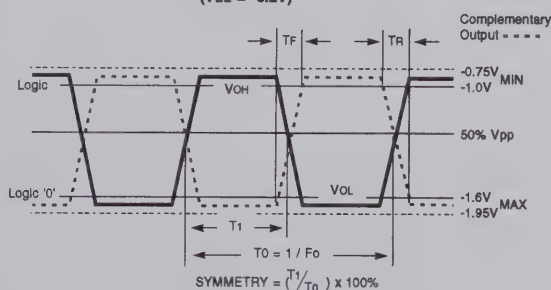
S1 in Position 1: IE1100FRSNOC (IE1100FRSNOA except pin 7 is ground)
S1 in Position 2: IE1100FRSNCOC (IE1100FRSCOA except pin 7 is ground)

ECL TEST CIRCUIT (without pull down resistors)



S1 in Position 1: IE1100FRSNOD (IE1100FRSNOB except pin 7 is ground)
S1 in Position 2: IE1100FRSCOD (IE1100FRSCOB except pin 7 is ground)


ECL WAVEFORM
(VEE = -5.2V)



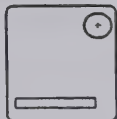
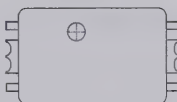
NOTES

TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS SELECTION GUIDE

PIN-THRU TCXOs

| PRODUCT | ITCX01912/IVCTCXO1912 |
|---------------------|---|
| |  |
| Frequency Range | 9.600 ~ 20.000 MHz |
| Frequency Stability | ±2.0 PPM -20°C ~ +70°C ±2.5 PPM -30°C ~ +70°C |
| Key Features | <ul style="list-style-type: none"> ✓ Tight Stability over Wide Temp. Range ✓ Adjustable Frequency ✓ Superior Quality |
| CATALOG PAGES | PAGE 42 |

SURFACE MOUNT TCXOs

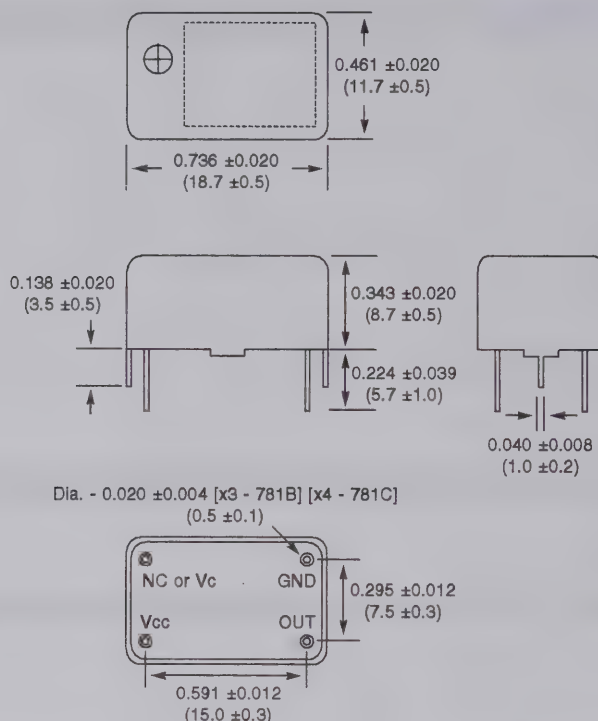
| PRODUCT | ISTCX01110 | ISTCX02112 |
|---------------------|--|--|
| |  |  |
| Frequency Range | 9.600 ~ 20.000 MHz | 9.600 ~ 20.000 MHz |
| Frequency Stability | ±2.5 PPM -30°C ~ 75°C | ±2.5 PPM -30°C ~ 75°C |
| Key Features | <ul style="list-style-type: none"> ✓ SMD TCXO ✓ Low Profile ✓ Wide Temp. Range ✓ Opt. Voltage Control ✓ Opt. 3.0 V Supply Voltage | <ul style="list-style-type: none"> ✓ SMD TCXO ✓ Wide Temp. Range ✓ Standard Footprint ✓ Opt. Voltage Control |
| CATALOG PAGES | PAGE 43 | PAGE 44 |

FREQUENCY RANGE BY PRODUCT

| PRODUCT | 1 MHz | 9MHz | 20 MHz |
|-----------------------|-------|------|-------------------|
| PIN THRU | | | |
| ITCX01912/IVCTCXO1912 | | | 9.600 ~ 20.000MHz |
| SURFACE MOUNT | | | |
| ISTCX01110B | | | 9.600 ~ 20.000MHz |
| ISTCX02112 | | | 9.600 ~ 20.000MHz |

ITCXO1912/IVCTCXO1912

**Fully Supported
For New Designs**



ELECTRICAL CHARACTERISTICS

| PARAMETERS | CONDITIONS | MIN. | MAX. | UNITS |
|--|---------------------------------|----------------------------|--------------|------------|
| Frequency Range | | 9.600 | 20.000 | MHz |
| Frequency Tolerance | Ta = 25°C | -0.5 | +0.5 | PPM |
| Frequency Stability | -20°C ~ +70°C -30°C ~ +75°C | -2.0 -2.5 | +2.0 +2.5 | PPM |
| Temperature Range (TOPR) (TSTG) | Operating Storage | -35 -55 | +85 +125 | °C |
| Supply Voltage (VDD) | | 4.7 | 5.3 | V |
| Input Current (IDD) | | | 2 | mA |
| Output Waveform | (Clipped SineWave) Vp-p | 1.0 | | V |
| Output Load | | | 20 5 | kΩ pF |
| Aging | Per Year @ 25°C | -1.0 | +1.0 | PPM |
| Frequency Stability vs Voltage Change | VDD = 5.0V±0.3V | -0.2 | +0.2 | PPM |
| Pullability (VCTCXO1912) Frequency Adjust Range | Vc = 2.5V ±2.0V Int. Trimmer | ±4.0 (IVCTCXO1912) ±3.0 | | PPM PPM |

Specifications available upon request.

* IVCTCXO1912- Voltage Control option.

All specifications subject to change without notice.

Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.



TCXO SMD TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

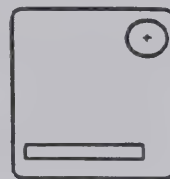
ISTCXO1110/ISVCTCXO1110

FEATURES

- ✓ Tight Stability
- ✓ Miniature Size
- ✓ Wide Temperature Range
- ✓ 3V Supply Voltage - L Version

APPLICATIONS

- ✓ Communications Equipment
- ✓ Cellular Phones
- ✓ Cordless Phones
- ✓ Portable Instrumentation
- ✓ Aerospace



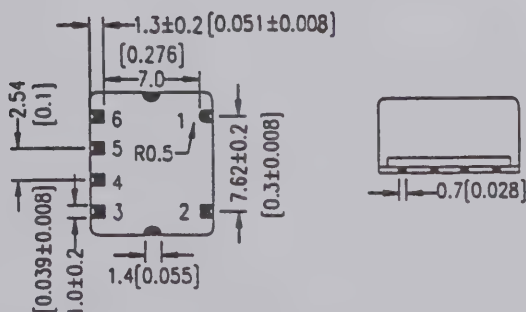
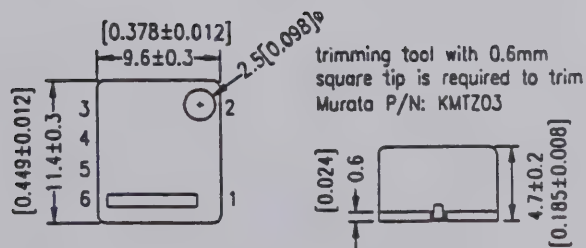
ELECTRICAL CHARACTERISTICS (Ta = 25°C, VDD = +5.0 V, CL = Max load)

| PARAMETERS | MIN. | MAX. | UNITS |
|--|-------|----------|----------|
| Frequency Range* (Fo) (9.60, 12.00, 12.80, 15.36, 19.20 STD) | 9.600 | 20.000 | MHz |
| Frequency Stability | | | |
| Over Temperature Range | -2.5 | +2.5 | PPM |
| Over Supply Voltage Change (VDD ±5%) | -0.3 | +0.3 | |
| Over Load Change 10 kΩ ±10%, 15 pF ±10% | -0.3 | +0.3 | |
| Temperature Range | | | |
| Operating Temperature (TOPR) | -30 | +75 | °C |
| Storage Temperature (TSTG) | -35 | +80 | |
| Supply Voltage (VDD) | +4.75 | +5.25 | V |
| Output Waveform (Clipped Sine) | | | |
| Peak-to-Peak Level (Vp-p) | 1.0 | | V |
| Input Current (IDD) | | 2.0 | mA |
| Output Load | | 10 15 | kΩ pF |
| Frequency Adjustment (Internal Trimmer) | ±3.0 | | PPM |
| Aging (per year at 25°C) | -1.0 | +1.0 | PPM |
| Voltage Control Option VCTCXO - Version (2.5 V ±2.0 V) | ±4.0 | | PPM |

* Other frequencies available. Consult ICM for your requirements.
All specifications subject to change without notice.

PIN CONNECTIONS

| ISTCXO1110 | |
|------------|---------------|
| #1 GND | #4 GND |
| #2 GND | #5 N.C. or Vc |
| #3 OUTPUT | #6 VDD |



Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.

See page 40 for tape and reel specifications.

TCXO SMD TEMPERATURE COMPENSATED CRYSTAL OSCILLATORS

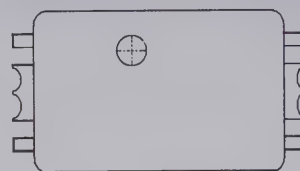
ISTCX02112

FEATURES

- ✓ Miniature Size
- ✓ Surface Mount
- ✓ Wide Temperature Range
- ✓ Tight Stability
- ✓ Optional Voltage Control

APPLICATIONS

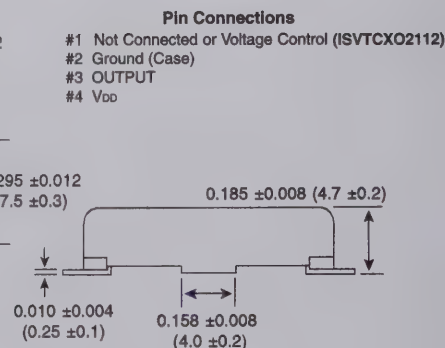
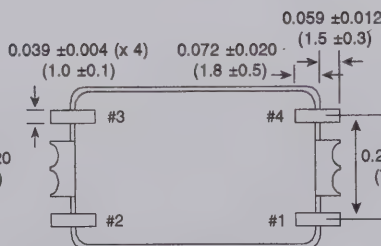
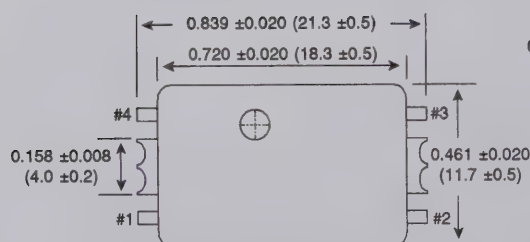
- ✓ Communications Equipment
- ✓ Cellular Phones
- ✓ Cordless Phones
- ✓ Aerospace
- ✓ Portable Instrumentation



ELECTRICAL CHARACTERISTICS (Ta = 25°C, VCC = +5.0 V, CL = 10 kΩ/10 pF)

| PARAMETERS | | MIN. | MAX. | UNITS |
|---|--------------------------------|-------|--------|-------|
| Frequency Range | (Fo) | 9.600 | 20.000 | MHz |
| Frequency Stability | | | | PPM |
| Over -30°C to +75°C | | -2.5 | +2.5 | |
| Over Supply Voltage Change (5.0 V ±0.3 V) | | -0.3 | +0.3 | |
| Temperature Range | | | | °C |
| Operating | (T _{OPR}) | -30 | +75 | |
| Storage | (T _{STG}) | -35 | +80 | |
| Supply Voltage | (VDD) | +4.75 | +5.25 | V |
| Output Waveform | (Clipped Sine) | | | V |
| Peak-to-Peak Level | (V _{p-p}) | 1.0 | | |
| Input Current | (IDD) | | 2.0 | mA |
| Output Load | | | 10 | kΩ |
| | | | 10 | pF |
| Frequency Adjustment | (Internal Trimmer) | ±3.0 | | PPM |
| Aging | (per year at 25°C) | -1.0 | +1.0 | PPM |
| Voltage Control Option | VCTCXO - (pin 1: 2.5 V ±2.0 V) | ±5.0 | | PPM |

All specifications subject to change without notice.



Inch dimensions shall govern.

All dimensions are in inches & parenthetically in millimeters.



MONOLITHIC CRYSTAL FILTERS

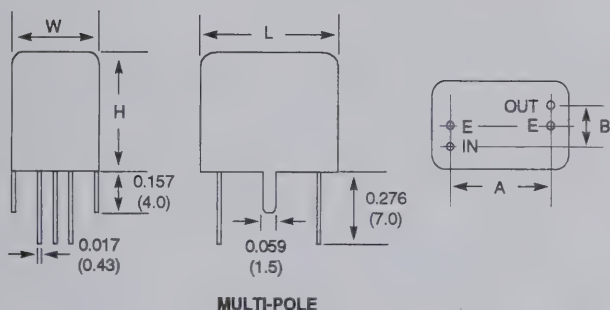
ICM filters offer excellent features such as sharp cut off characteristics, low loss and high stability over a wide temperature range which are superior to LC Filters and Ceramic Filters.

The basic building block for all custom built ICM filters is the two-pole monolithic filter available in standard package as shown. Two-pole monolithic filters are cascaded to produce four, six and eight pole filter responses with the addition of coupling capacitors between two-pole sections. Standard ICM filters are available with center frequencies from 10.7 MHz to 90 MHz, and from two to eight poles.

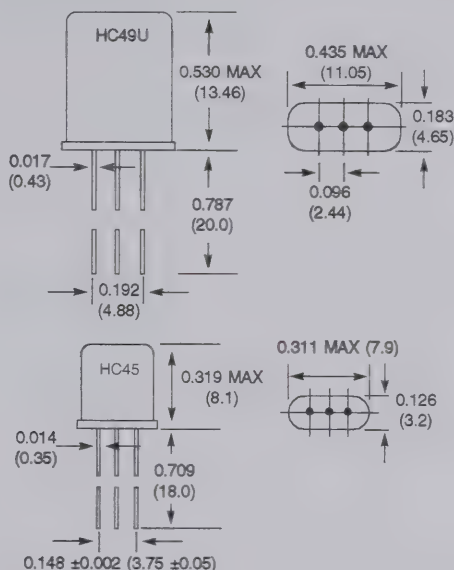
For custom made filters, please specify the following:

- Holder Size • Insertion Loss • Ripple • Nominal Frequency • Attenuation • Terminating Impedance • Pass Bandwidth • Spurious Response • Operating Temp. Range

Note: 45F Series 45.000 MHz fundamental is a special filter designed for mobile radio and cellular phone applications.



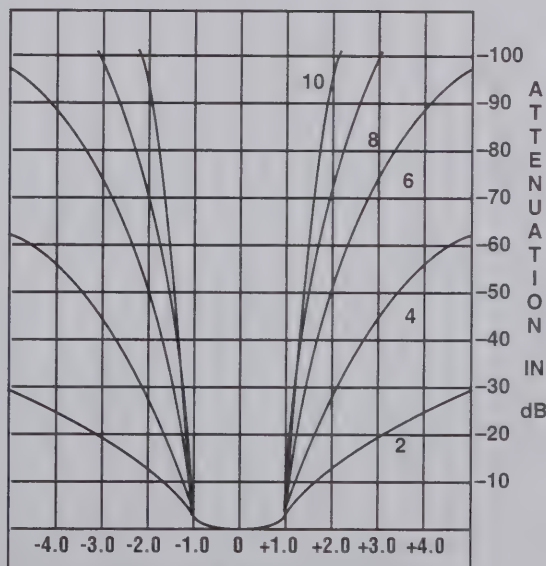
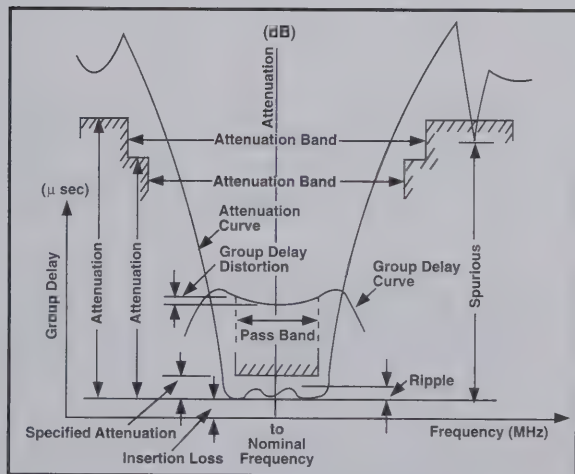
MULTI-POLE



TWO-POLE

MULTI-POLE PACKAGE DIMENSIONS

| CASE TYPE | L | W | H | A | B |
|-----------|--------------|--------------|--------------|--------------|--------------|
| SF101 | 0.590 (15.0) | 0.472 (12.0) | 0.591 (15.0) | 0.354 (9.0) | 0.197 (5.0) |
| SF102 | 0.728 (18.5) | 0.472 (12.0) | 0.591 (15.0) | 0.531 (13.5) | 0.197 (5.0) |
| SF103 | 0.433 (11.0) | 0.335 (8.5) | 0.453 (11.5) | 0.291 (7.4) | 0.148 (3.75) |
| SF104 | 0.527 (13.4) | 0.335 (8.5) | 0.453 (11.5) | 0.386 (9.8) | 0.148 (3.75) |



SHAPE FACTOR VS NUMBER OF POLES

CRYSTAL FILTERS

Monolithic Crystal Filters (MCF)

10.7MHz

| Model No. | Nominal Frequency (MHz) | Pole | Pass Band | | Attenuation Band | | Ripple Max. (dB) | Loss Max. (dB) | Attenuation Guaranteed | | Terminating Impedance (ohm/pF) | Operating Temperature (C) | Package Style |
|-----------|-------------------------|------|-----------|-------|------------------|-------|------------------|----------------|------------------------|----------------|--------------------------------|---------------------------|---------------|
| | | | (dB) | (kHz) | (dB) | (kHz) | | | (dB) | (Fo \pm kHz) | | | |

✓ 12.5 kHz Channel Spacing

| | | | | | | | | | | | | | |
|-------|--------|---|---|------------|----|------------|-----|-----|-------|---------------------------|-----------|---------|-----------|
| 10M7A | 10.700 | 2 | 3 | ± 3.75 | 20 | ± 18.0 | 0.5 | 1.5 | 35/40 | +300~-+1000 -200~-1000 | 1.8K//6.0 | -20~+70 | HC-49/U |
| 10M7B | 10.700 | 4 | 3 | ± 3.75 | 40 | ± 14.0 | 1.0 | 2.5 | 50/70 | +300~-+1000 -200~-1000 | 1.8K//5.0 | -20~+70 | HC-49/Ux2 |
| 10M7C | 10.700 | 6 | 3 | ± 3.75 | 65 | ± 12.5 | 2.0 | 3.5 | 65 | $\pm 12.5 \sim \pm 300$ | 1.8K//5.0 | -20~+70 | SF 101 |
| 10M7D | 10.700 | 8 | 3 | ± 3.75 | 90 | ± 12.5 | 2.0 | 4.0 | 90 | $\pm 12.5 \sim \pm 300$ | 1.8K//5.0 | -20~+70 | SF 102 |

✓ 20 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|-----------|----|------------|-----|-----|-------|---------------------------|-----------|---------|----------|
| 10M12A | 10.700 | 2 | 3 | ± 6.0 | 20 | ± 25.0 | 0.5 | 1.5 | 35/40 | +300~-+1000 -200~-1000 | 3.3K//1.5 | -20~+70 | HC-49/U |
| 10M12B | 10.700 | 4 | 3 | ± 6.0 | 40 | ± 20.0 | 1.0 | 2.5 | 50/70 | +300~-+1000 -200~-1000 | 3.3K//1.5 | -20~+70 | HC49/UX2 |
| 10M12C | 10.700 | 6 | 3 | ± 6.0 | 65 | ± 20.0 | 2.0 | 3.0 | 65 | $\pm 20.0 \sim \pm 300$ | 3.3K//2.0 | -20~+70 | SF 101 |
| 10M12D | 10.700 | 8 | 6 | ± 6.0 | 90 | ± 20.0 | 2.0 | 3.5 | 90 | $\pm 20.0 \sim \pm 300$ | 3.3K//2.0 | -20~+70 | SF 102 |

✓ 25 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|-----------|----|------------|-----|-----|-------|---------------------------|-----------|---------|-----------|
| 10M15A | 10.700 | 2 | 3 | ± 7.5 | 18 | ± 25.0 | 0.5 | 1.5 | 35/40 | +300~-+1000 -200~-1000 | 3.0K//2.0 | -20~+70 | HC-49/U |
| 10M15B | 10.700 | 4 | 3 | ± 7.5 | 40 | ± 25.0 | 1.0 | 2.5 | 50/70 | +300~-+1000 -200~-1000 | 3.0K//2.0 | -20~+70 | HC-49/Ux2 |
| 10M15C | 10.700 | 6 | 3 | ± 7.5 | 65 | ± 25.0 | 2.0 | 3.0 | 65 | $\pm 25.0 \sim \pm 300$ | 3.3K//1.5 | -20~+70 | SF 101 |
| 10M15D | 10.700 | 8 | 6 | ± 7.5 | 90 | ± 25.0 | 2.0 | 3.5 | 90 | $\pm 25.0 \sim \pm 300$ | 3.3K//1.5 | -20~+70 | SF 102 |

✓ 50 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|------------|----|------------|-----|-----|-------|---------------------------|------------|---------|-----------|
| 10M30A | 10.700 | 2 | 3 | ± 15.0 | 15 | ± 50.0 | 0.5 | 1.5 | 30/35 | +300~-+1000 -200~-1000 | 5.0K//0 | -20~+70 | HC-49/U |
| 10M30B | 10.700 | 4 | 3 | ± 15.0 | 30 | ± 40.0 | 1.0 | 2.5 | 65/80 | +300~-+1000 -200~-1000 | 5.0K//~1.0 | -20~+70 | HC-49/Ux2 |
| 10M30C | 10.700 | 6 | 3 | ± 15.0 | 60 | ± 45.0 | 2.0 | 2.5 | 60 | $\pm 45.0 \sim \pm 300$ | 5.0K//~1.0 | -20~+70 | SF 101 |
| 10M30D | 10.700 | 8 | 6 | ± 15.0 | 80 | ± 40.0 | 2.0 | 3.0 | 80 | $\pm 40.0 \sim \pm 300$ | 5.0K//~1.0 | -20~+70 | SF 102 |

21.4 MHz

| Model No. | Nominal Frequency (MHz) | Pole | Pass Band | | Attenuation Band | | Ripple Max. (dB) | Loss Max. (dB) | Attenuation Guaranteed | | Terminal Impedance (ohm/pF) | Operating Temperature (C) | Package Style |
|-----------|-------------------------|------|-----------|-------|------------------|-------|------------------|----------------|------------------------|----------------|-----------------------------|---------------------------|---------------|
| | | | (dB) | (kHz) | (dB) | (kHz) | | | (dB) | (Fo \pm kHz) | | | |

✓ 12.5 kHz Channel Spacing

| | | | | | | | | | | | | | |
|-------|--------|---|---|------------|----|------------|-----|-----|-------|---------------------------|----------|---------|---------|
| 21M7A | 21.400 | 2 | 3 | ± 3.75 | 20 | ± 18.0 | 0.5 | 1.5 | 35/50 | +350~-+1000 -200~-1000 | 850//6.0 | -20~+70 | HC-45 |
| 21M7B | 21.400 | 4 | 3 | ± 3.75 | 40 | ± 14.0 | 1.0 | 2.5 | 65/80 | +350~-+1000 -200~-1000 | 850//5.0 | -20~+70 | HC-45x2 |
| 21M7C | 21.400 | 6 | 3 | ± 3.75 | 65 | ± 12.5 | 2.0 | 3.0 | 65 | $\pm 12.5 \sim \pm 300$ | 850//5.0 | -20~+70 | SF 103 |
| 21M7D | 21.400 | 8 | 3 | ± 3.75 | 90 | ± 12.5 | 2.0 | 4.0 | 90 | $\pm 12.5 \sim \pm 300$ | 850//5.0 | -20~+70 | SF 104 |

✓ 20 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|-----------|----|------------|-----|-----|-------|---------------------------|-----------|---------|---------|
| 21M12A | 21.400 | 2 | 3 | ± 6.0 | 20 | ± 25.0 | 0.5 | 1.5 | 35/50 | +350~-+1000 -200~-1000 | 1.2K//3.0 | -20~+70 | HC-45 |
| 21M12B | 21.400 | 4 | 3 | ± 6.0 | 40 | ± 20.0 | 1.0 | 2.5 | 65/80 | +350~-+1000 -200~-1000 | 1.2K//2.5 | -20~+70 | HC-45x2 |
| 21M12C | 21.400 | 6 | 3 | ± 6.0 | 65 | ± 20.0 | 2.0 | 3.5 | 65 | $\pm 20.0 \sim \pm 300$ | 1.2K//2.5 | -20~+70 | SF 103 |
| 21M12D | 21.400 | 8 | 3 | ± 6.0 | 90 | ± 20.0 | 2.0 | 3.0 | 90 | $\pm 20.0 \sim \pm 300$ | 1.2K//2.5 | -20~+70 | SF104 |

✓ 25 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|-----------|----|------------|-----|-----|-------|---------------------------|-----------|---------|---------|
| 21M15A | 21.400 | 2 | 3 | ± 7.5 | 18 | ± 25.0 | 0.5 | 1.5 | 35/50 | +350~-+1000 -200~-1000 | 1.5K//2.0 | -20~+70 | HC-45 |
| 21M15B | 21.400 | 4 | 3 | ± 7.5 | 40 | ± 25.0 | 1.0 | 2.5 | 65/80 | +350~-+1000 -200~-1000 | 1.5K//2.0 | -20~+70 | HC-45x2 |
| 21M15C | 21.400 | 6 | 3 | ± 7.5 | 65 | ± 25.0 | 2.0 | 2.5 | 65 | $\pm 25.0 \sim \pm 300$ | 1.5K//2.0 | -20~+70 | SF 103 |
| 21M15D | 21.400 | 8 | 3 | ± 7.5 | 90 | ± 25.0 | 2.0 | 3.5 | 90 | $\pm 25.0 \sim \pm 300$ | 1.5K//2.0 | -20~+70 | SF 104 |

✓ 50 kHz Channel Spacing

| | | | | | | | | | | | | | |
|--------|--------|---|---|------------|----|------------|-----|-----|-------|---------------------------|------------|---------|---------|
| 21M30A | 21.400 | 2 | 3 | ± 15.0 | 15 | ± 45.0 | 0.5 | 1.5 | 35/40 | +350~-+1000 -300~-1000 | 3.0K//0.5 | -20~+70 | HC 45 |
| 21M30B | 21.400 | 4 | 3 | ± 15.0 | 40 | ± 50.0 | 1.0 | 2.5 | 65/80 | +350~-+1000 -300~-1000 | 3.0K//~0.5 | -20~+70 | HC-45x2 |
| 21M30C | 21.400 | 6 | 3 | ± 15.0 | 65 | ± 50.0 | 2.0 | 2.5 | 65 | $\pm 50.0 \sim \pm 300$ | 2.2K//0.5 | -20~+70 | SF 103 |
| 21M30D | 21.400 | 8 | 3 | ± 15.0 | 80 | ± 50.0 | 2.0 | 3.0 | 80 | $\pm 50.0 \sim \pm 300$ | 2.2K//0.5 | -20~+70 | SF 104 |



CRYSTAL FILTERS

HIGH FREQUENCY SERIES

| Model No. | Nominal Frequency (MHz) | Pole | Pass Band | | Attenuation Band | | Ripple Max. (dB) | Loss Max. (dB) | Attenuation Guaranteed | | Terminating Impedance (ohm/pF) | Operating Temperature (C) | Package Style |
|-----------|-------------------------|------|-----------|-------|------------------|-------|------------------|----------------|------------------------|----------|--------------------------------|---------------------------|---------------|
| | | | (dB) | (kHz) | (dB) | (kHz) | | | (dB) | (F0±kHz) | | | |

✓ Fundamental Tone

| | | | | | | | | | | | | | |
|---------|--------|---|---|-------|----|-------|-----|-----|----------|--------------------------|-----------|---------|---------|
| 45MF7A | 45.000 | 2 | 3 | ±3.75 | 10 | ±12.5 | 1.0 | 2.5 | 65 | ±910 | 300//10.0 | -20~+70 | HC-45 |
| 45MF7B | 45.000 | 4 | 3 | ±3.75 | 30 | ±12.5 | 1.0 | 4.0 | 90 | ±910 | 300// 8.0 | -20~+70 | HC-45x2 |
| 45MF15A | 45.000 | 2 | 3 | ±7.5 | 15 | ±25.0 | 1.0 | 2.0 | 35 40 | +500~+1000 -200~-1000 | 650// 4.5 | -20~+70 | HC-45 |
| 45MF15B | 45.000 | 4 | 3 | ±7.5 | 30 | ±25.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 650// 1.5 | -20~+70 | HC-45x2 |
| 45MF20A | 45.000 | 2 | 3 | ±10.0 | 15 | ±34.0 | 1.0 | 2.0 | 35 40 | +500~+1000 -200~-1000 | 700// 2.5 | -20~+70 | HC-45 |
| 45MF20B | 45.000 | 4 | 3 | ±10.0 | 40 | ±48.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 700// 1.5 | -20~+70 | HC-45x2 |
| 45MF30A | 45.000 | 2 | 3 | ±15.0 | 15 | ±50.0 | 1.0 | 2.0 | 35 | +500~+1000 -300~-1000 | 800// 1.5 | -20~+70 | HC-45 |
| 45MF30B | 45.000 | 4 | 3 | ±15.0 | 40 | ±60.0 | 1.0 | 3.0 | 70 | +500~+1000 -300~-1000 | 800// 1.0 | -20~+70 | HC-45x2 |

✓ 3rd Overtone

| | | | | | | | | | | | | | |
|--------|--------|---|---|-------|----|-------|-----|-----|----|--------------------------|-------------|---------|---------|
| 45M7A | 45.000 | 2 | 3 | ±3.75 | 10 | ±12.5 | 1.0 | 2.5 | 35 | ±910 | 2.5K// -0.5 | -20~+70 | HC-45 |
| 45M7B | 45.000 | 4 | 3 | ±3.75 | 30 | ±12.5 | 1.0 | 4.0 | 75 | ±910 | 2.5K// -0.5 | -20~+70 | HC-45x2 |
| 45M15A | 45.000 | 2 | 3 | ±7.5 | 18 | ±28.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 4K// -1.0 | -20~+70 | HC-45 |
| 45M15B | 45.000 | 4 | 3 | ±7.5 | 40 | ±30.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 4K// -1.0 | -20~+70 | HC-45x2 |
| 45M20A | 45.000 | 2 | 3 | ±10.0 | 15 | ±30.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 5K// -1.0 | -20~+70 | HC-45 |
| 45M20B | 45.000 | 4 | 3 | ±10.0 | 35 | ±40.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 5K// -1.0 | -20~+70 | HC-45x2 |
| 45M30A | 45.000 | 2 | 3 | ±15.0 | 15 | ±50.0 | 1.0 | 2.0 | 30 | +500~+1000 -300~-1000 | 8K// -1.0 | -20~+70 | HC-45 |
| 45M30B | 45.000 | 4 | 3 | ±15.0 | 30 | ±50.0 | 1.0 | 3.0 | 70 | +500~+1000 -300~-1000 | 8K// -1.0 | -20~+70 | HC-45x2 |

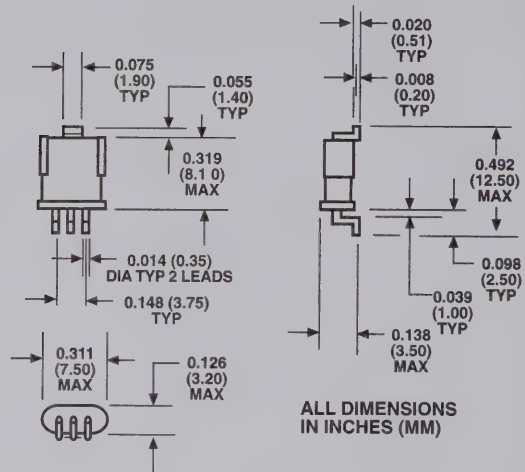
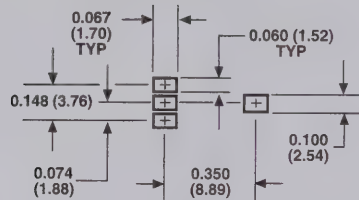
| | | | | | | | | | | | | | |
|--------|--------|---|---|-------|----|-------|-----|-----|----|--------------------------|-------------|---------|---------|
| 70M15A | 70.000 | 2 | 3 | ±7.5 | 15 | ±30.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 2.0K// -1.0 | -20~+70 | HC-45 |
| 70M15B | 70.000 | 4 | 3 | ±7.5 | 25 | ±25.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 2.0K// -1.0 | -20~+70 | HC-45x2 |
| 70M20A | 70.000 | 2 | 3 | ±10.0 | 15 | ±40.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 2.5K// -1.0 | -20~+70 | HC-45 |
| 70M20B | 70.000 | 4 | 3 | ±10.0 | 35 | ±40.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 2.5K// -1.0 | -20~+70 | HC-45x2 |

| | | | | | | | | | | | | | |
|--------|--------|---|---|-------|----|-------|-----|-----|----|--------------------------|-------------|---------|---------|
| 90M15A | 90.000 | 2 | 3 | ±7.5 | 15 | ±30.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 1.4K// 0 | -35~+70 | HC-45 |
| 90M15B | 90.000 | 4 | 3 | ±7.5 | 25 | ±25.0 | 1.0 | 3.5 | 70 | +500~+1000 -200~-1000 | 1.4K// 0 | -35~+70 | HC-45x2 |
| 90M20A | 90.000 | 2 | 3 | ±10.0 | 15 | ±40.0 | 1.0 | 2.0 | 35 | +500~+1000 -200~-1000 | 1.5K// -1.0 | -35~+70 | HC-45 |
| 90M20B | 90.000 | 4 | 3 | ±10.0 | 35 | ±40.0 | 1.0 | 3.0 | 70 | +500~+1000 -200~-1000 | 1.5K// -1.0 | -35~+70 | HC-45x2 |
| 90M30A | 90.000 | 2 | 3 | ±15.0 | 15 | ±50.0 | 1.0 | 2.0 | 35 | +500~+1000 -300~-1000 | 4K// -1.0 | -35~+70 | HC-45 |
| 90M30B | 90.000 | 4 | 3 | ±15.0 | 25 | ±50.0 | 1.0 | 3.0 | 70 | +500~+1000 -300~-1000 | 4K// -1.0 | -35~+70 | HC-45x2 |

SURFACE MOUNT PACKAGES

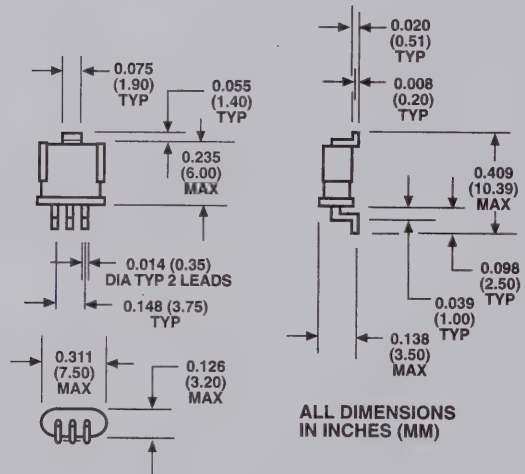
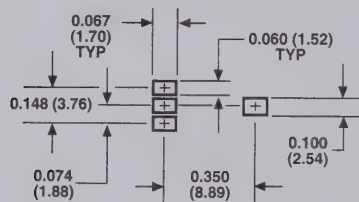
UM-1 Surface Mount Option

SUGGESTED SOLDER PAD LAYOUT



UM-5 Surface Mount Option

SUGGESTED SOLDER PAD LAYOUT



CRYSTAL DATA

Typical Crystal Design

Before beginning a design or purchase of a crystal there are system parameters which must be considered. Below are questions which need to be determined by your system. These parameters will determine the crystal specifications.

1. On what crystal frequency do you wish to operate?
2. How much can the frequency be off at room temperature (+25C)?
3. What is the temperature range over which the crystal will operate?
4. How much can the crystal change frequency over the temperature range?
5. Is the crystal to be operated at Series or Parallel resonant?
6. If operated at parallel. What is the parallel capacitance in picofarads (pF)?
7. Is pullability important?
8. What holder type or can size do you require?

The Quartz Crystal

The quartz crystal may be represented by the L, C, R circuit (Below).

CO is the capacitance formed by the crystal electrodes plus any holder capacitance. The LI, CI, RI branch is called the “motional arm”. The motional capacitance, CI, controls the “pullability” of the crystal. The shift of a crystal can be calculated by the following formula...

$$\text{ppm fr Series} = \text{CI}/2 \text{ (CO+CL)}$$

Knowing two different loads on the crystal, we can look at the differences between each shift from series to calculate total trim range.

Example: given a 0.020 pF CI and a CO of 4.26 pF the shift from series of a 20 pF load is 412.2 ppm and the shift of a 27 pF load is 319.9 ppm. This gives us a tune range of 92.3 ppm between 20 pF and 27 pF loads.

CI and RI can be specified on any crystal. Typical values of RI are 10 to 25 ohms on the fundamental mode and higher on overtones. Typical motional capacitance values are between 0.016 pF and 0.034 pF for a fundamental crystal. Motional capacitance is divided by the overtone squared. Static capacitance (CO) is about 213 times CI on the fundamental mode.

Frequency

The quartz crystal can be made on frequencies between 70 kHz and 200 MHz. The quartz crystal is designed to operate on its fundamental frequency or one of its overtones. The overtones are related to the fundamental frequency and occur at odd harmonic intervals. (1, 3, 5, 7, etc.)

This becomes important between the 15 MHz to 30 MHz Range. Crystals in that frequency range can be made as either a fundamental or 3rd overtone. Fundamental mode crystals at these frequencies become very expensive as the quartz blank is extremely thin and difficult to handle, and therefore causing a higher rate of breakage in processing. If you specify an overtone mode instead of the fundamental, the cost savings may be significant.

Calibration

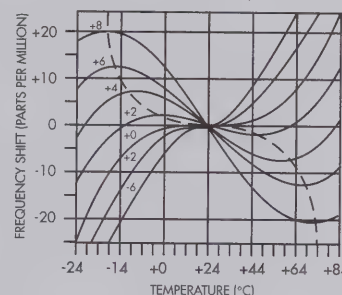
Crystals are the key components in an oscillator circuit and they are affected by ambient conditions, particularly the temperature.

The most common calibration specification is ± 10 ppm or $\pm 0.001\%$ at $+25^{\circ}\text{C}$ and your specific load, it is also the least expensive.

Temperature Calibration

The chart to the right shows the change in frequency with respect to temperature. The various curves are dependent on the angle at which the quartz is cut from the original crystal. The angle of cut is controlled by x-ray diffraction techniques.

The curves in this chart show that as the tolerance becomes tighter, the operation temperature range is reduced.



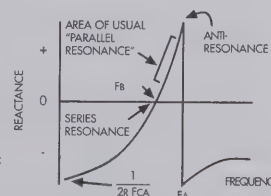
Crystal Load

Series Resonance

When a crystal is operating at series resonance (f_s), it looks resistive in the circuit. Thus, its impedance at f_s is near zero. In a well designed series resonant circuit, correlation is not a problem and load capacitance does not have to be specified.

Parallel Resonance (antiresonance)

The crystal's impedance values will have the effect of pulling the frequency of the crystal. If the crystal is to be used at parallel resonance, the load capacity (in picofarads) should always be specified. Load capacity is the dynamic capacity of the total circuit measured or computed across the crystal terminals. It is selected to operate the crystal at a stable point on fs-fa reactance curve (10pf to close to fs). For more information on computing the load capacity of a circuit see our Oscillator Data sheet.



CRYSTAL OSCILLATOR DATA

Typical Crystal Oscillator Design

An oscillator is an amplifier with a feedback loop from output to input. Barkhausen criteria states that for oscillation to occur the product of the gains around a loop must be equal to or greater than unity and that the sum of the phase shifts around the loop must be a multiple of 360°.

Before beginning a design or purchase of an oscillator there are system parameters which the oscillator will need to conform to. Below are questions which need to be determined by your system. These parameters will determine the type of oscillator you will require (TCXO, TCVCXO, VCXO, Clock, Ovenized).

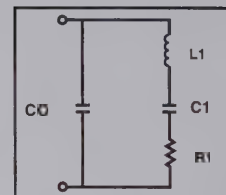
- 1) What frequency do you wish to operate on?
- 2) How much can the frequency vary in your system?
- 3) What is the temperature range the oscillator will operate in?
- 4) What power is available to operate the oscillator?
 - a) What is the voltage level and its tolerance?
 - b) How much current can the oscillator consume?
- 5) How large can this oscillator be physically?
- 6) What output wave shape is required in your system?
 - (TTL, CMOS, ECL, Sine Wave)
 - a) Sinewave level and harmonic levels required
- 7) What type of load will the output of the oscillator experience?
 - (ex. 50 ohms)
- 8) How closely does the oscillator need to be set to frequency?
- 9) Do you need a trimmer to compensate for aging or crystal differences?
- 10) How much can the oscillator shift frequency over time?
- 11) Does your system require control of the frequency by a voltage?
 - a) What is the direction of frequency vs. voltage?
 - b) Is the control AC or DC (modulation or PLL)?
 - c) What is the voltage control range?
 - d) What is the minimum and maximum frequency change required
 - e) Do you need the frequency change vs. the voltage change to be linear?

The Quartz Crystal

The quartz crystal may be represented by the L,C,R circuit (Upper Right).

CO is the capacitance formed by the crystal electrodes plus any holder capacitance. The LI, CI,

RI branch is called the "motional arm". The motional capacitance, CI, controls the "pullability" of the crystal. The shift of a crystal can be calculated by the following formula....



$$\text{PPm fr Series} = \frac{C1}{2 * (C0 + CL)}$$

Knowing two different loads on the crystal, we can look at the differences between each shift from series to calculate the total trim range.

C1 and R1 can be specified on any crystal. Typical values of R1 are 10 to 25 ohms on the fundamental mode and higher on overtones. Typical motional capacitance values are between 0.018 pf and 0.024 pf for a fundamental crystal. Motional capacitance is divided by the overtone squared. Static capacitance (CO) is about 213 times C1 on the fundamental mode.

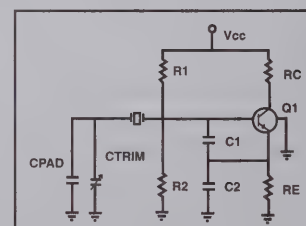
L1 can be calculated knowing the series frequency of the crystal.

Example: given a 0.020 pf C1 and a C0 of 4.26pf the shift from series of a 20pf load is 412.2 ppm and the shift of a 27pf load is 319.9 ppm. This gives us a tune range of 92.3ppm between 20 pf and 27 pf loads.

Fundamental Oscillators

MODIFIED COLPITTS OSCILLATOR

The oscillating loop C1, C2 in parallel with RE, Ctrim in parallel with Cpad and the crystal can be isolated from load effects in the colpitts oscillator by keeping $RC \ll RE$. The output waveform at the collector is highly distorted due to the self limiting of the oscillator drawing pulses of collector current. The trimmer in this design has only a second order effect on loop gain. The loop gain in this circuit is controlled by the gain of the transistor and the reactance and ratio of C1 and C2. To begin with the reactance of C2 should be -j75 ohms and the reactance of C1 should be slightly larger.

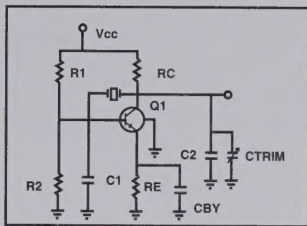


MODIFIED COLPITTS OSCILLATOR

$$\text{Crystal load capacity} = \frac{1}{\frac{1}{C1} + \frac{1}{C2} + \frac{1}{(Cpad + Ctrim)}}$$

PIERCE OSCILLATOR

The oscillating loop C1 in parallel with R2, Ctrim in parallel with C2 & Rc and the crystal is directly tied to the load causing poor load stability. The trimmer is across one of the feedback capacitors and directly effects loop gain. The output waveform at the collector is relatively sinusoidal.



PIERCE OSCILLATOR

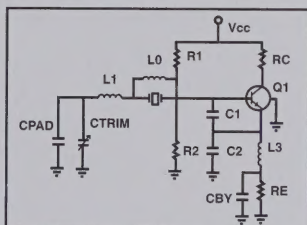
$$\text{Crystal load capacity} = \frac{1}{\frac{1}{C1} + \frac{1}{(C_{pad} + C_{trim})}}$$

Overtone Oscillators

C1 (C2 + Ctrim)

OVERTONE COLPITTS OSCILLATOR

The design considerations are the same as the modified colpitts oscillator. Tune C2 and L3 to the frequency directly between the desired overtone and the overtone just below. Choose values of C2 and L3 such that X_{C2} in parallel with $X_{L3} = -j75$ ohms. The static capacitance of the crystal can be canceled by placing an inductor across the crystal, from the crystal to ground or from the crystal to the emitter of the transistor. This will increase the drive on the crystal. Cby is used to increase the Q of the trap.



OVERTONE COLPITTS

$$\text{Load} = \frac{1}{W \left(X_{C_{pad} + C_{trim}} + X_{L1} + X_{C1} + \frac{1}{\frac{1}{X_{L3}} + \frac{1}{X_{C2}}} \right)}$$

$$W = 2\pi F$$

OVERTONE PIERCE

L1/C2 form a trap in the same manner as C2/L3 in the colpitts oscillator. Choose L1 and C2 in the manner outlined in the "Overtone Colpitts" design. As in the colpitts design an inductor can be added to tone out the effect of the crystal's static capacitance (C0).

$$\text{Load} = \frac{1}{W \left(X_{C1} + \frac{1}{\frac{1}{X_{C_{pad} + C_{trim}}} + \frac{1}{X_{L1}}} \right)}$$

Nth Overtone Oscillators

GROUNDING BASE CONFIGURATIONS

These oscillators may be tuned initially by placing an AC short across the crystal and tuning Ctrim. These are basically amplifiers with a tapped capacitor resonant circuit in the collector. The tapped capacitor should match the impedances of the input and output. In the "Grounded Base Butler" Oscillator the loop gain may be increased by shunting Re.

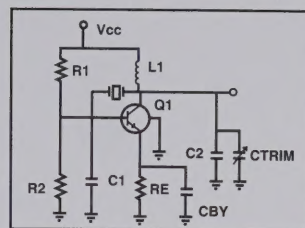
Crystal Load Capacity = Series

TWO TRANSISTOR BUTLER

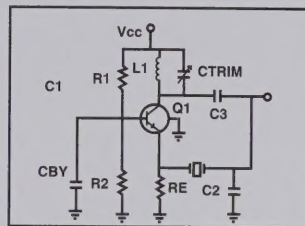
The butler oscillator has the ability of high frequency good load stability and output amplitude gain.

This circuit is commonly used in wide pull VCXOs and TCVCXOs.

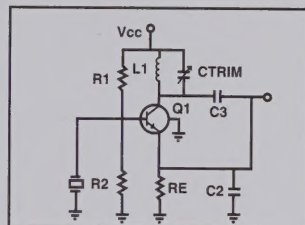
Crystal Load Capacity = Series



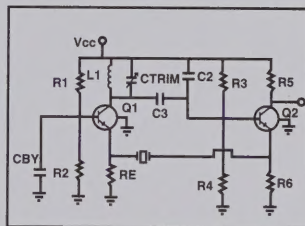
OVERTONE PIERCE



GROUNDING BASE BUTLER OSCILLATOR

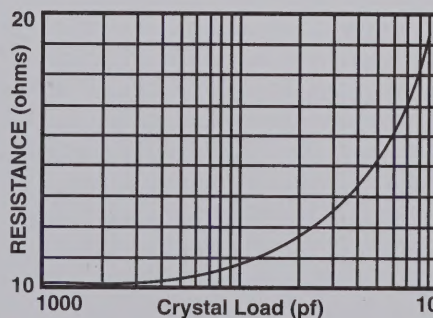


GROUNDING BASE OSCILLATOR



TWO TRANSISTOR BUTLER OSCILLATOR

NOTE: Crystal loads should be kept between series and 10 pf. The lighter the load the higher the apparent series resistance. Tolerances at lighter loads cause more variations in crystal calibration tolerance.



RESEARCH REPORT

COMPARISON OF THE EFFECTS OF TWO DIFFERENT TREATMENTS ON THE GROWTH OF PLANTS

The purpose of this study was to determine the effect of two different treatments on the growth of plants. The treatments were applied to a group of plants, and the results were compared.

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